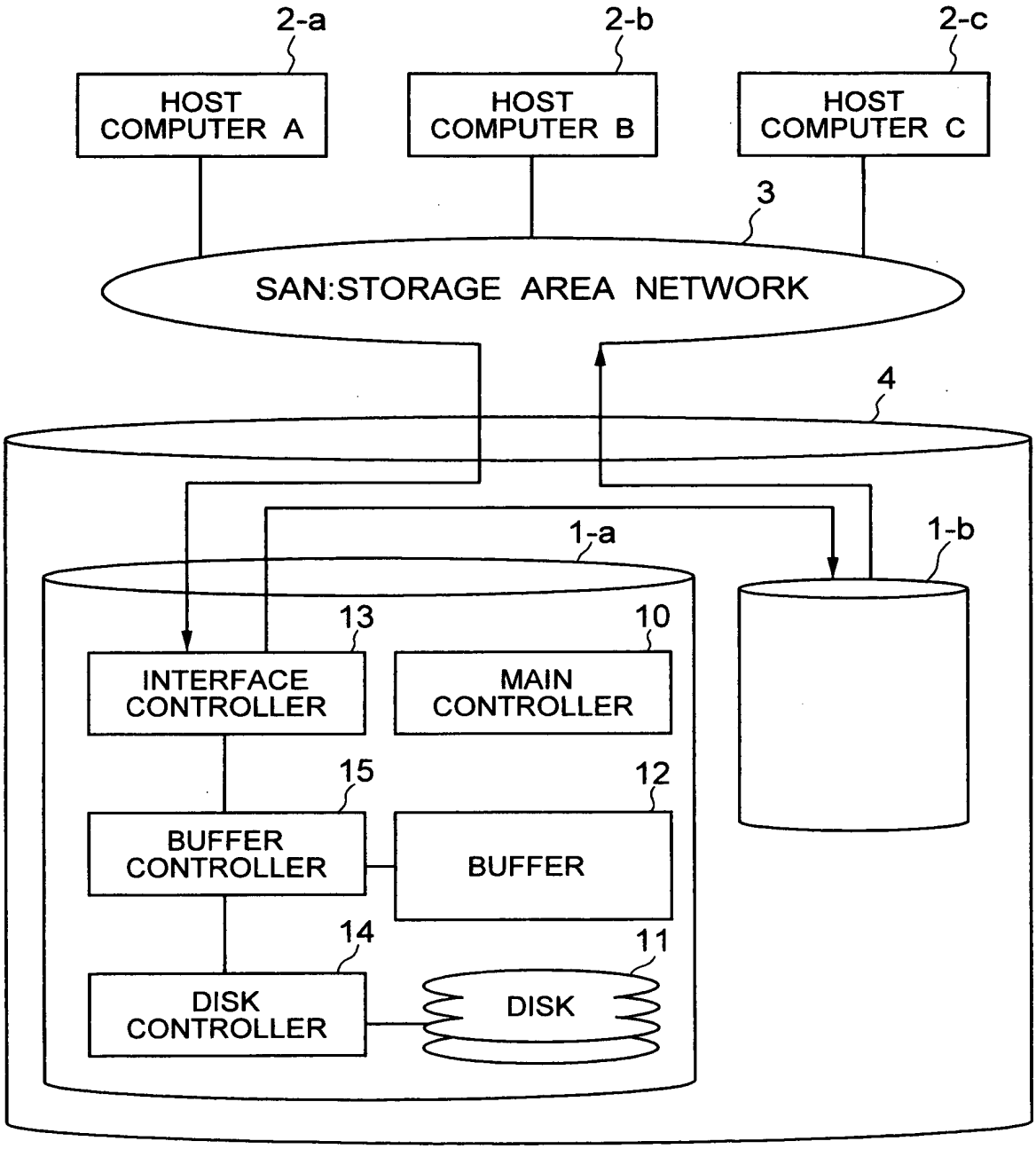
FIG. 1



2002-503602

FIG. 2

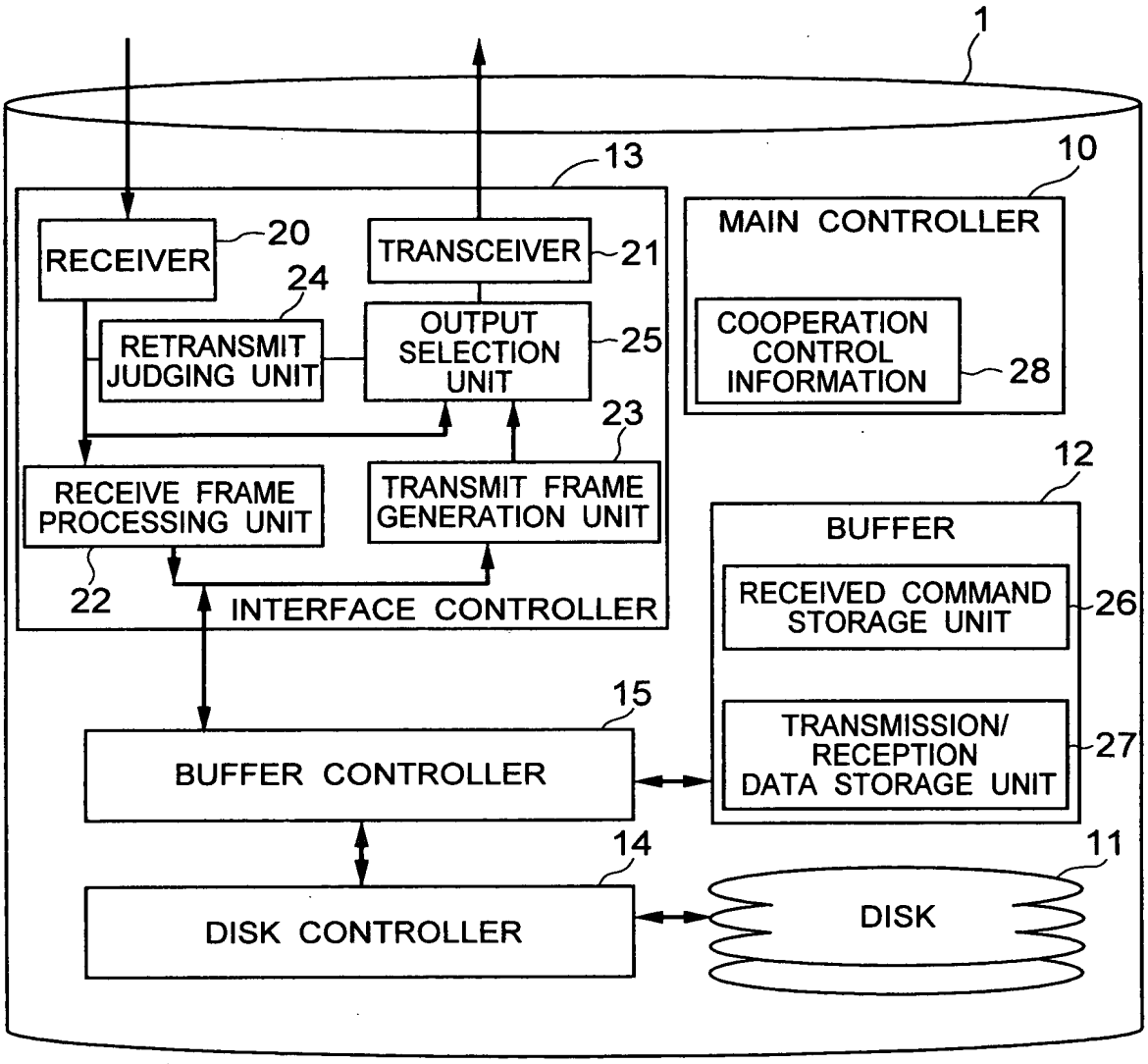

1
13
10
RECEIVER
20
TRANSCEIVER
21
MAIN CONTROLLER
24
RETRANSMIT JUDGING UNIT
OUTPUT SELECTION UNIT
25
COOPERATION CONTROL INFORMATION
28
23
12
RECEIVE FRAME PROCESSING UNIT
TRANSMIT FRAME GENERATION UNIT
BUFFER
22
INTERFACE CONTROLLER
RECEIVED COMMAND STORAGE UNIT
26
15
TRANSMISSION/ RECEPTION DATA STORAGE UNIT
27
BUFFER CONTROLLER
14
11
DISK CONTROLLER
DISK

FIG. 3

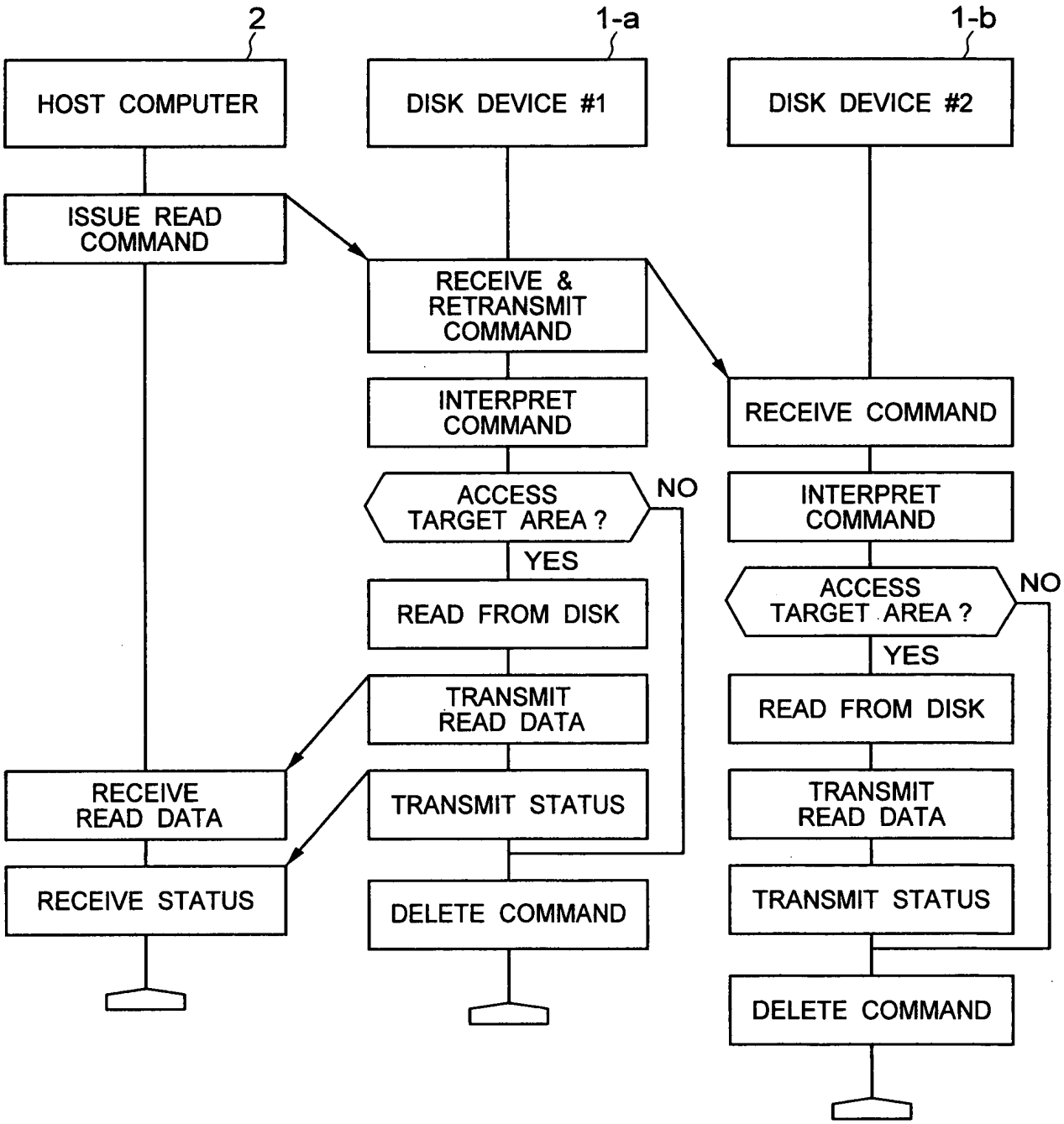


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FIG. 4

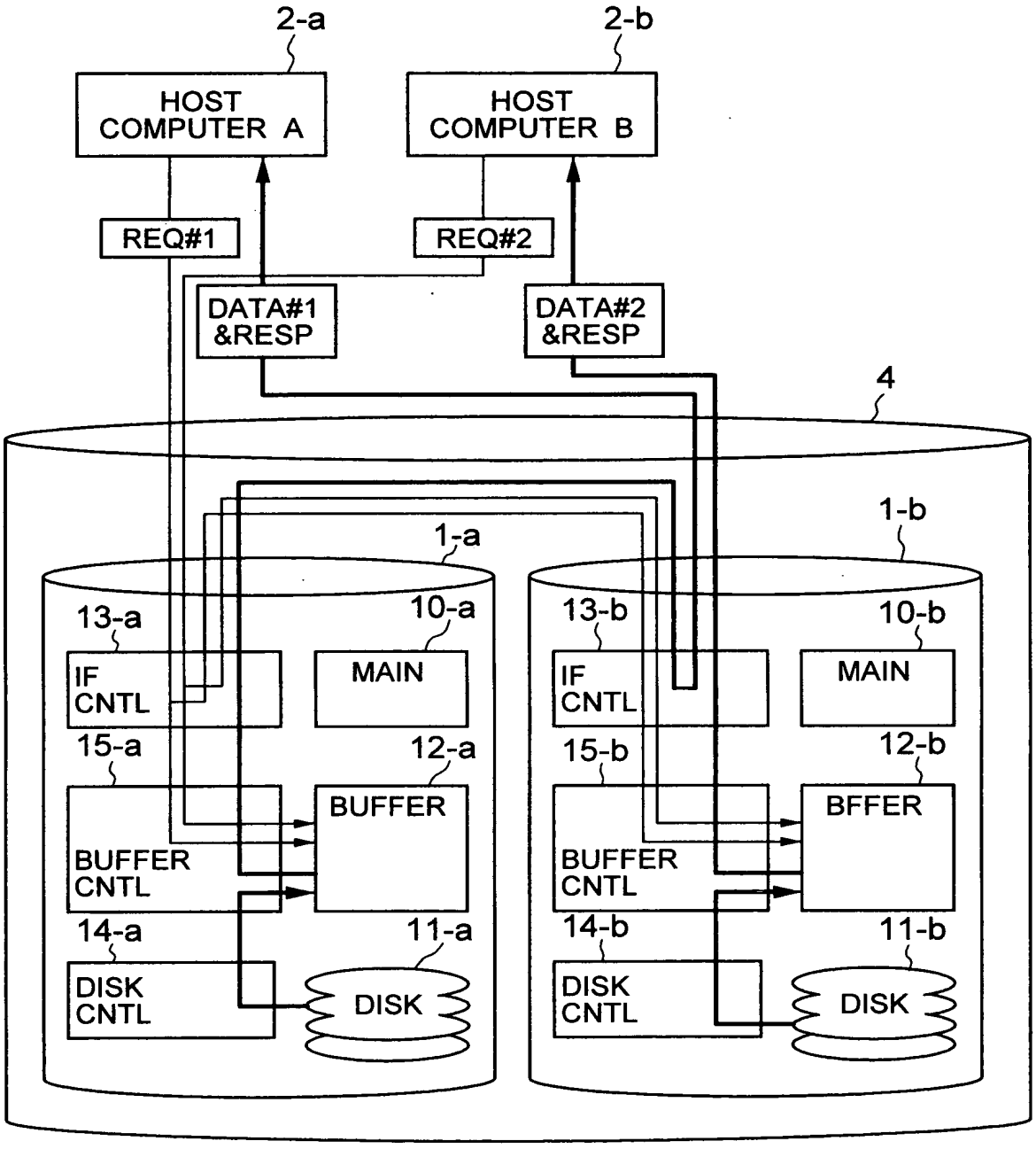
2-a
2-b
HOST COMPUTER A
HOST COMPUTER B
REQ#1
REQ#2
DATA#1 &RESP
DATA#2 &RESP
4
1-a
1-b
13-a
10-a
IF CNTL
MAIN
15-a
12-a
BUFFER
BUFFER CNTL
14-a
11-a
DISK CNTL
DISK
13-b
10-b
IF CNTL
MAIN
15-b
12-b
BFFER
BUFFER CNTL
14-b
11-b
DISK CNTL
DISK

FIG. 5

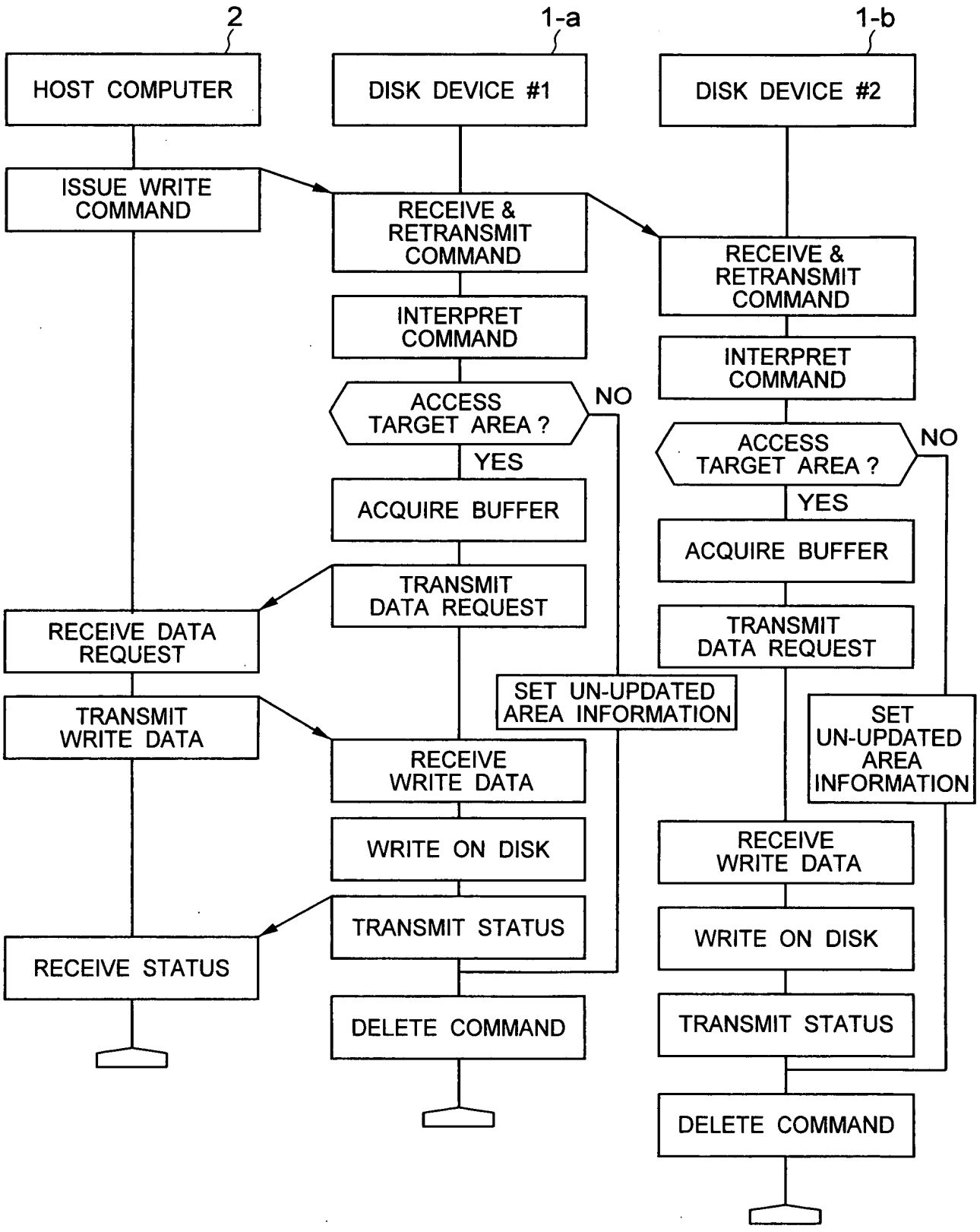

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FIG. 6

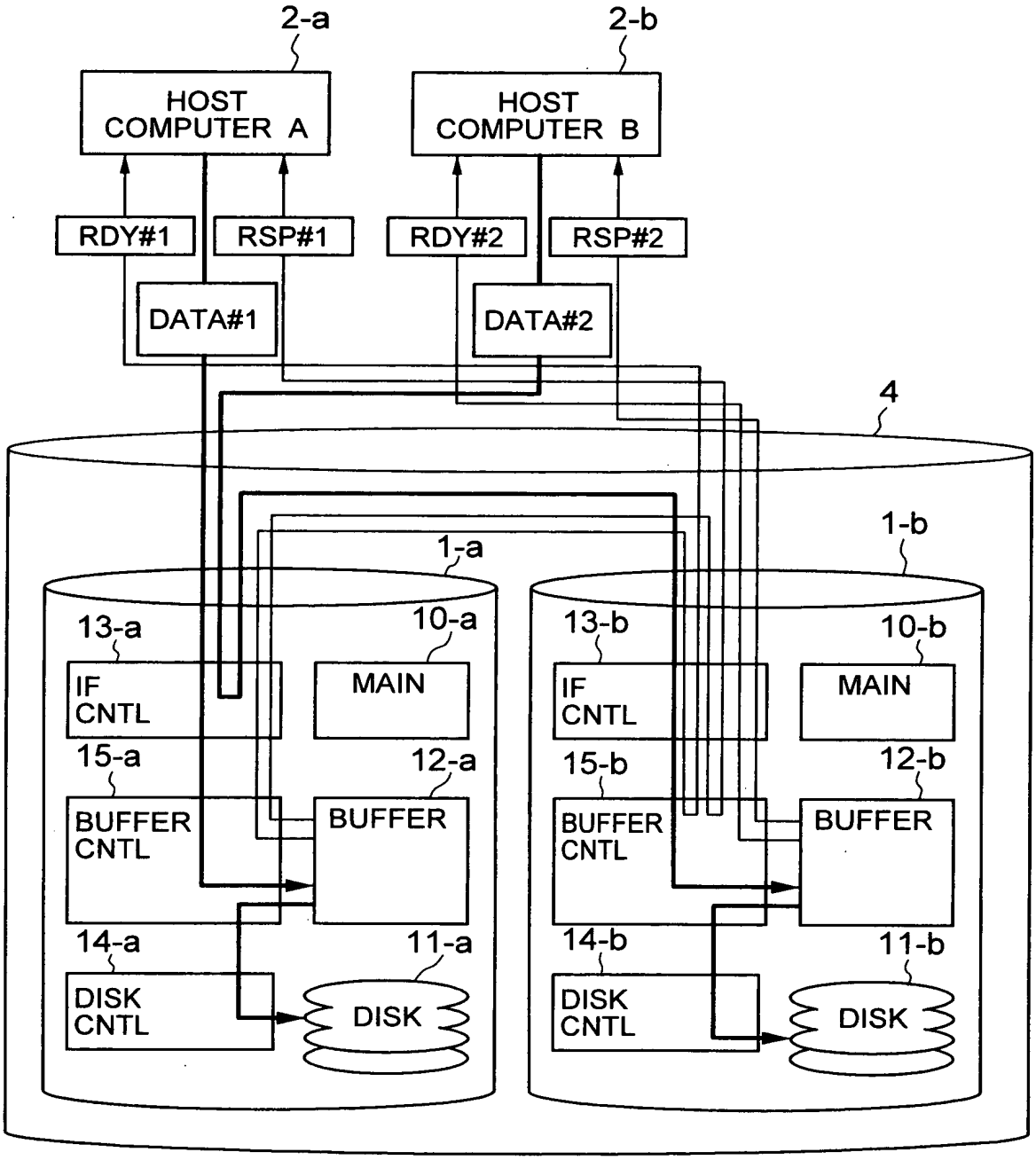
2-a
2-b
HOST COMPUTER A
HOST COMPUTER B
RDY#1
RSP#1
RDY#2
RSP#2
DATA#1
DATA#2
4
1-a
1-b
13-a
10-a
IF CNTL
MAIN
15-a
12-a
BUFFER CNTL
BUFFER
14-a
11-a
DISK CNTL
DISK
13-b
10-b
IF CNTL
MAIN
15-b
12-b
BUFFER CNTL
BUFFER
14-b
11-b
DISK CNTL
DISK

FIG. 7

30

#	UN-UPDATED AREA START ADDRESS	UN-UPDATED AREA SIZE	UPDATE INFORMATION
0			
1			
2			
·			
N			

FIG. 8

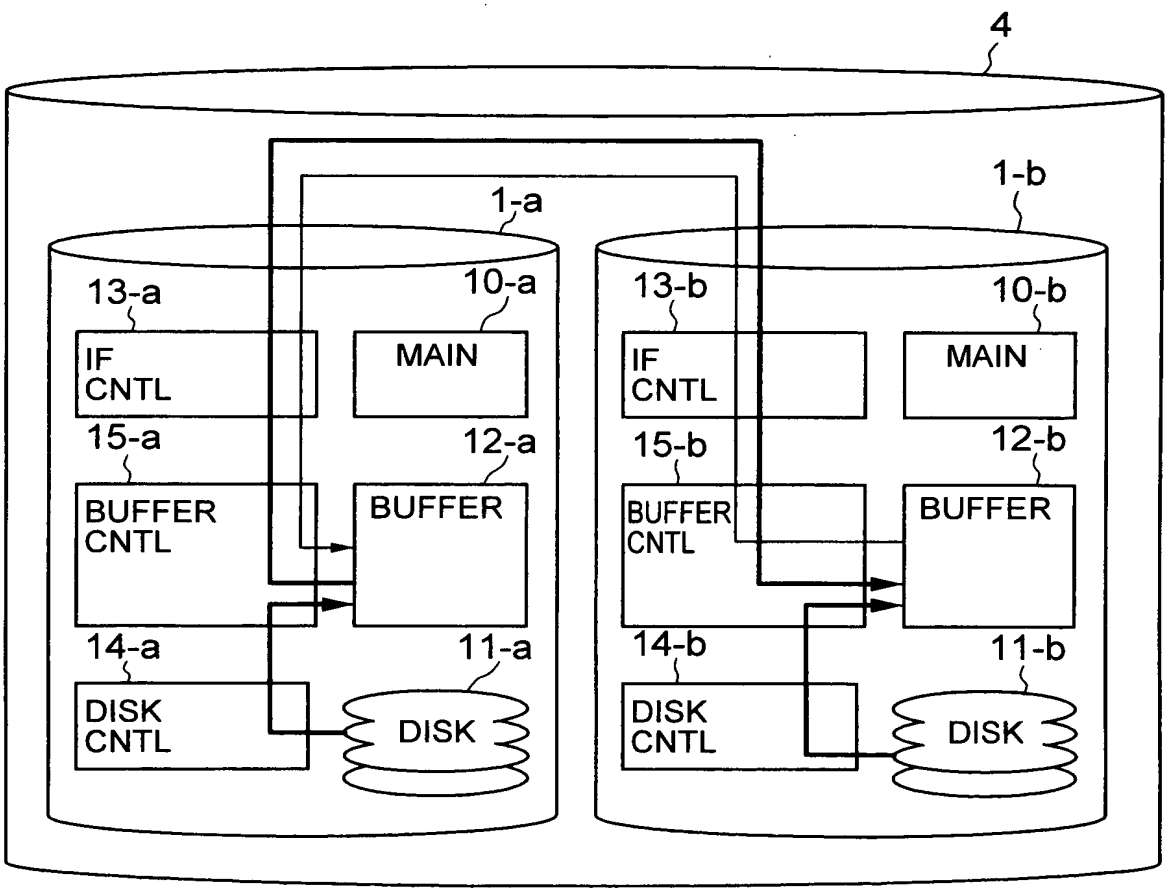

FIG. 9

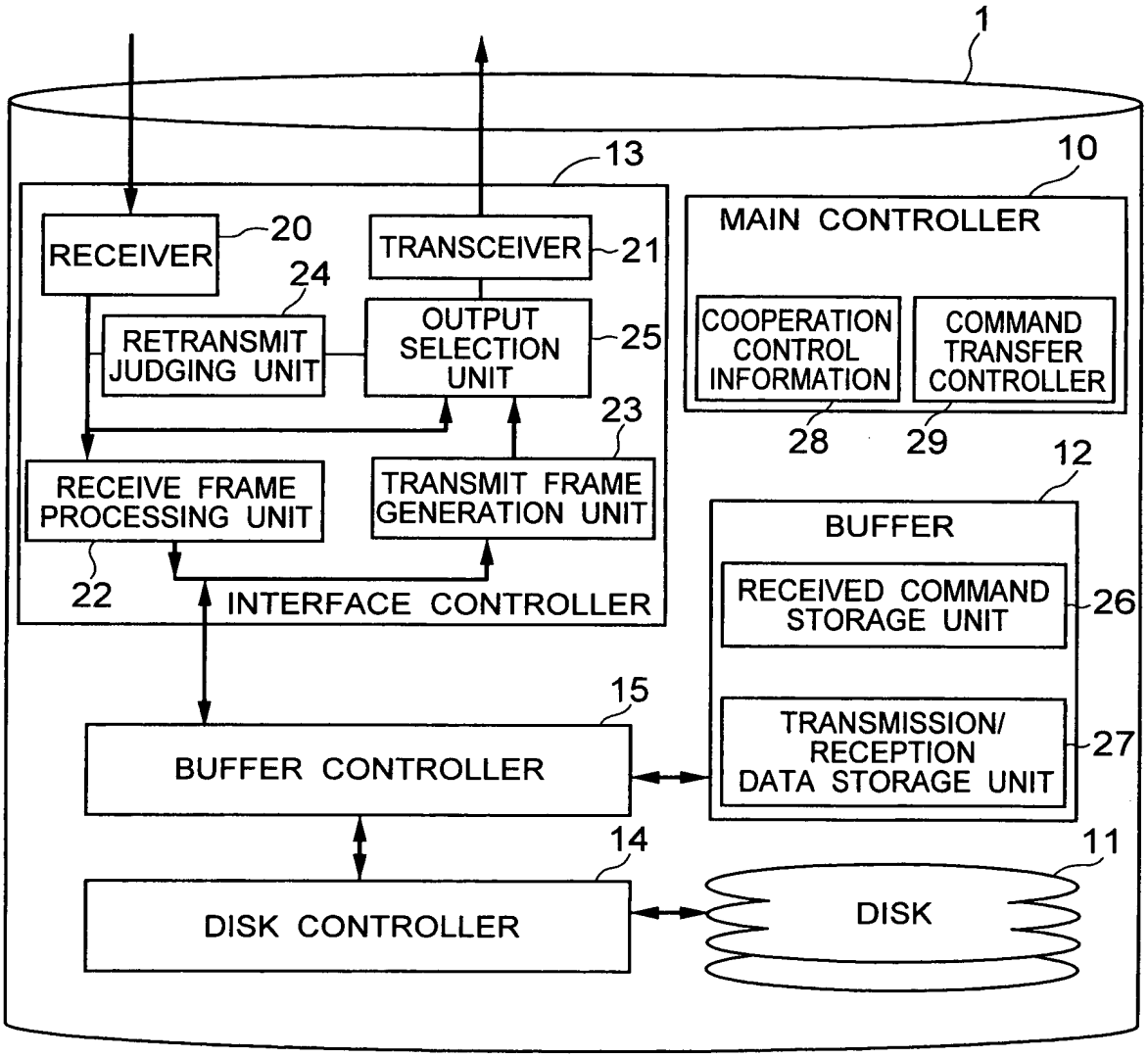
1
13
10
RECEIVER
20
TRANSCEIVER
21
MAIN CONTROLLER
24
RETRANSMIT JUDGING UNIT
OUTPUT SELECTION UNIT
25
COOPERATION CONTROL INFORMATION
COMMAND TRANSFER CONTROLLER
23
28
29
12
RECEIVE FRAME PROCESSING UNIT
TRANSMIT FRAME GENERATION UNIT
BUFFER
22
INTERFACE CONTROLLER
RECEIVED COMMAND STORAGE UNIT
26
15
TRANSMISSION/ RECEPTION DATA STORAGE UNIT
27
BUFFER CONTROLLER
14
11
DISK CONTROLLER
DISK

FIG. 10

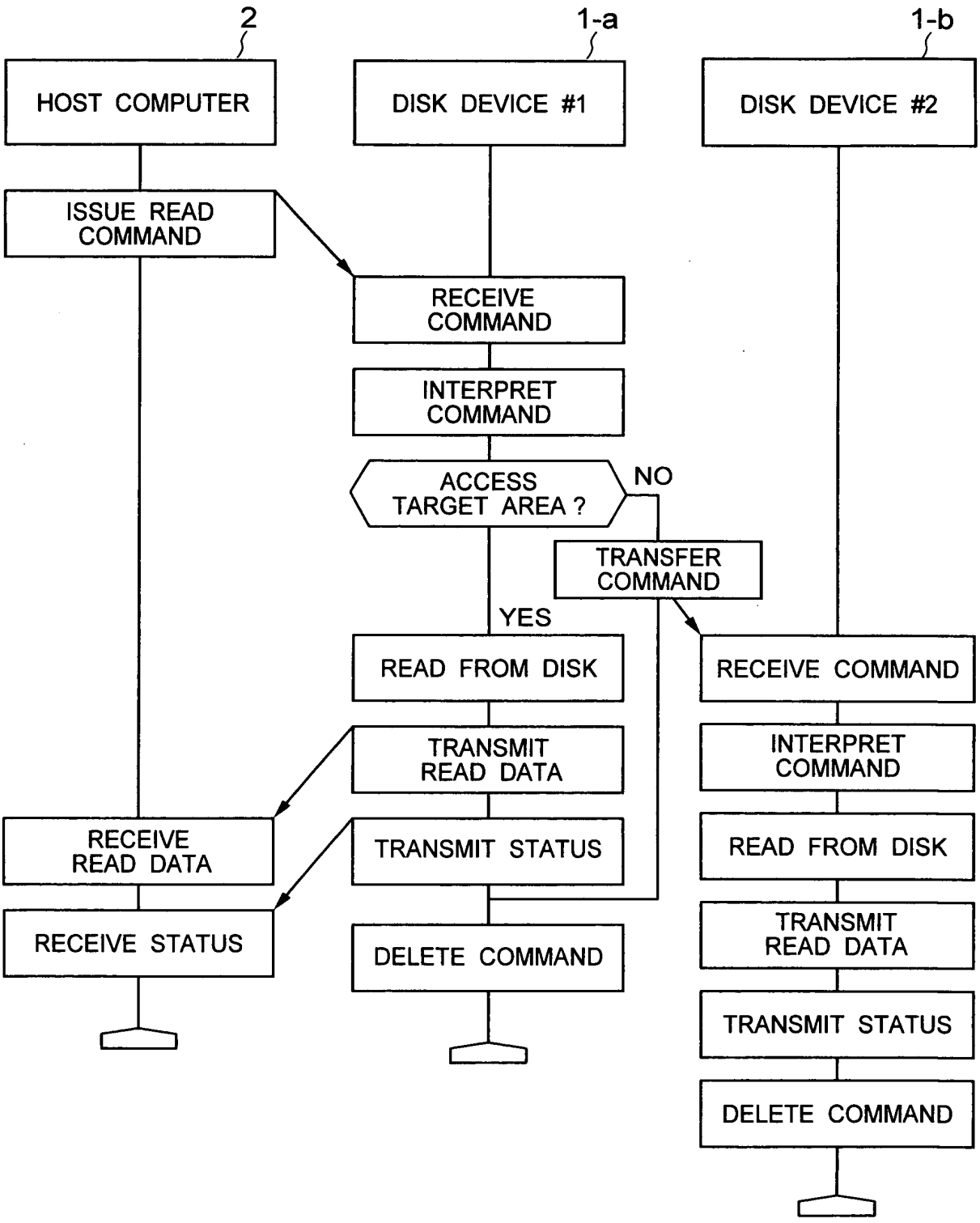

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FIG. 11

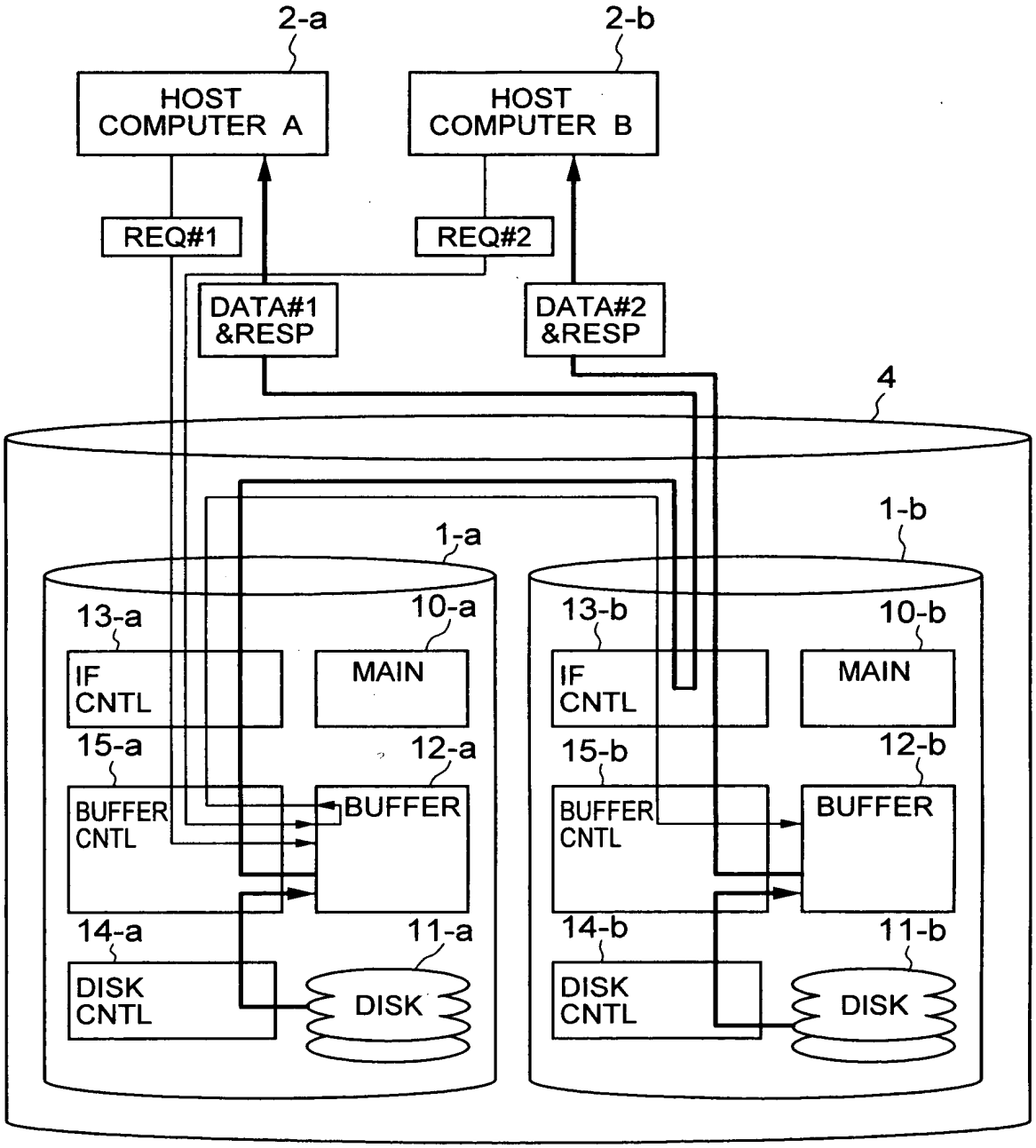
2-a
2-b
HOST COMPUTER A
HOST COMPUTER B
REQ#1
REQ#2
DATA#1 &RESP
DATA#2 &RESP
4
1-a
1-b
13-a
10-a
13-b
10-b
IF CNTL
MAIN
IF CNTL
MAIN
15-a
12-a
15-b
12-b
BUFFER CNTL
BUFFER
BUFFER CNTL
BUFFER
14-a
11-a
14-b
11-b
DISK CNTL
DISK
DISK CNTL
DISK

FIG. 12

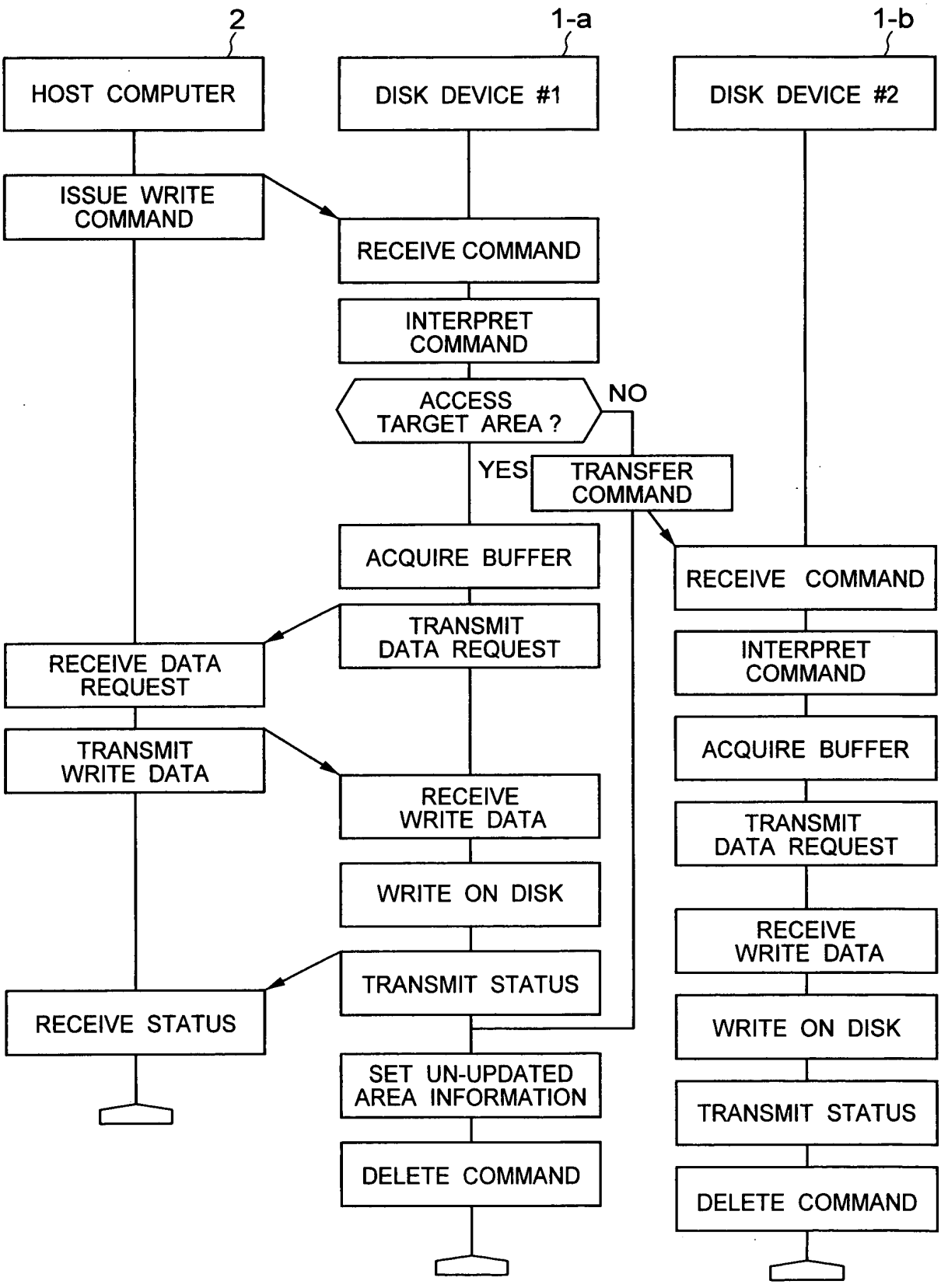

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FIG. 13

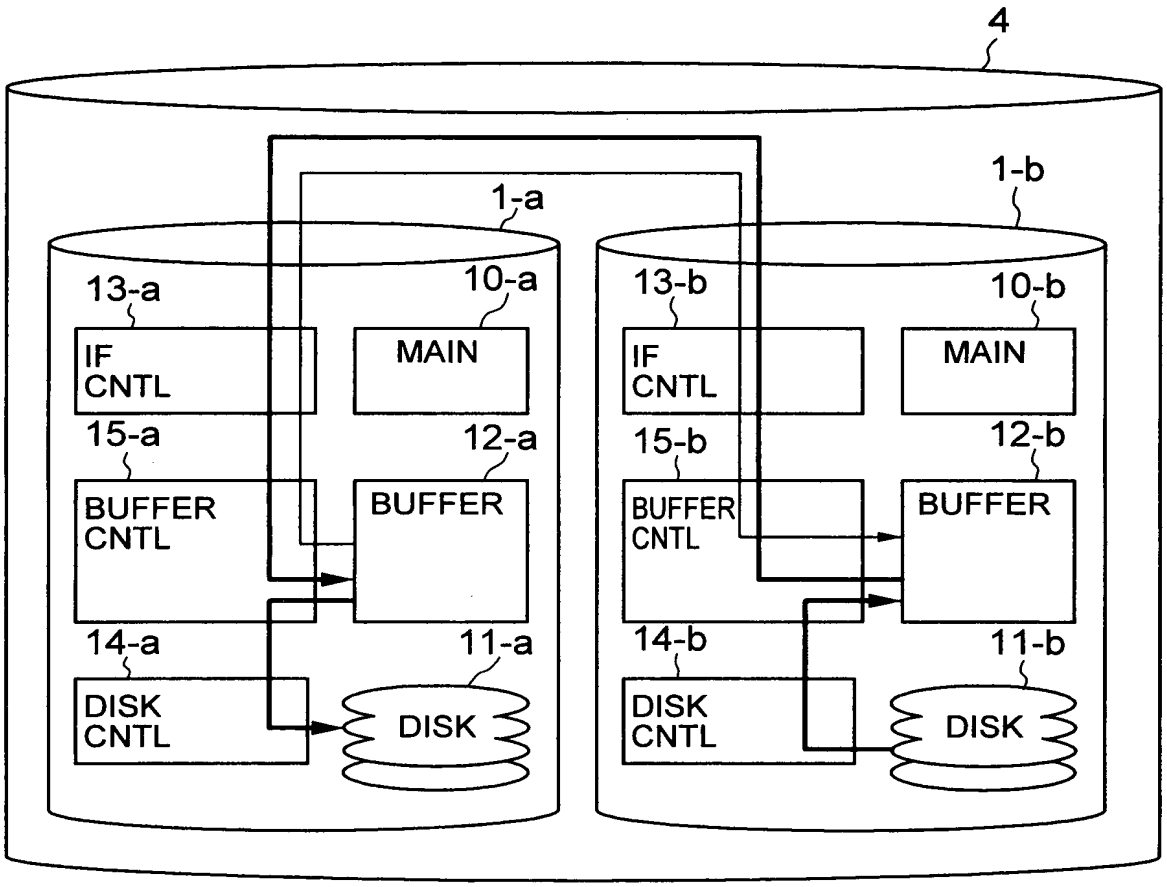
4
1-a
1-b
13-a
10-a
IF CNTL
MAIN
15-a
12-a
BUFFER CNTL
BUFFER
14-a
11-a
DISK CNTL
DISK
13-b
10-b
IF CNTL
MAIN
15-b
12-b
BUFFER CNTL
BUFFER
14-b
11-b
DISK CNTL
DISK

FIG. 14

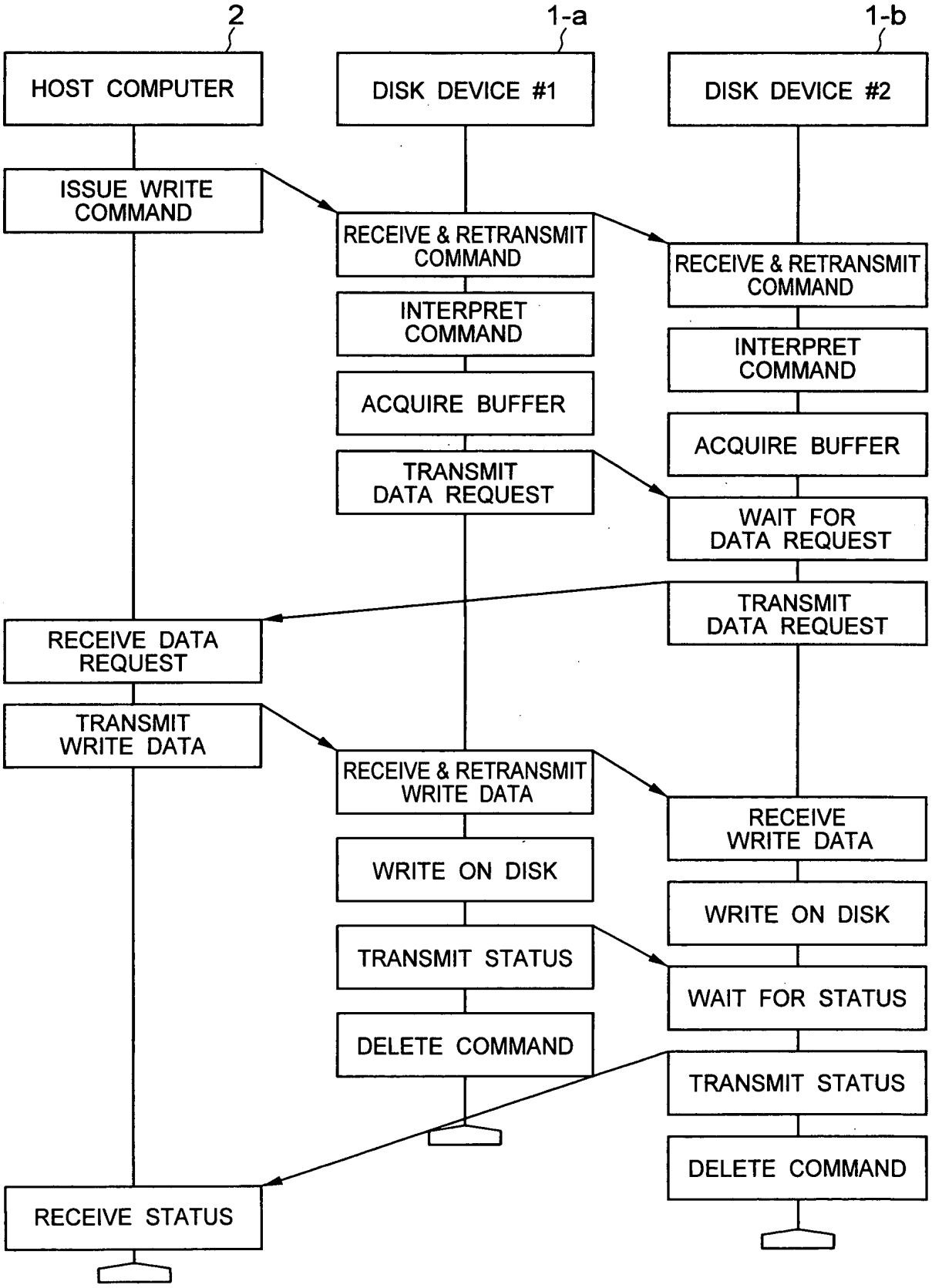

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FIG. 15

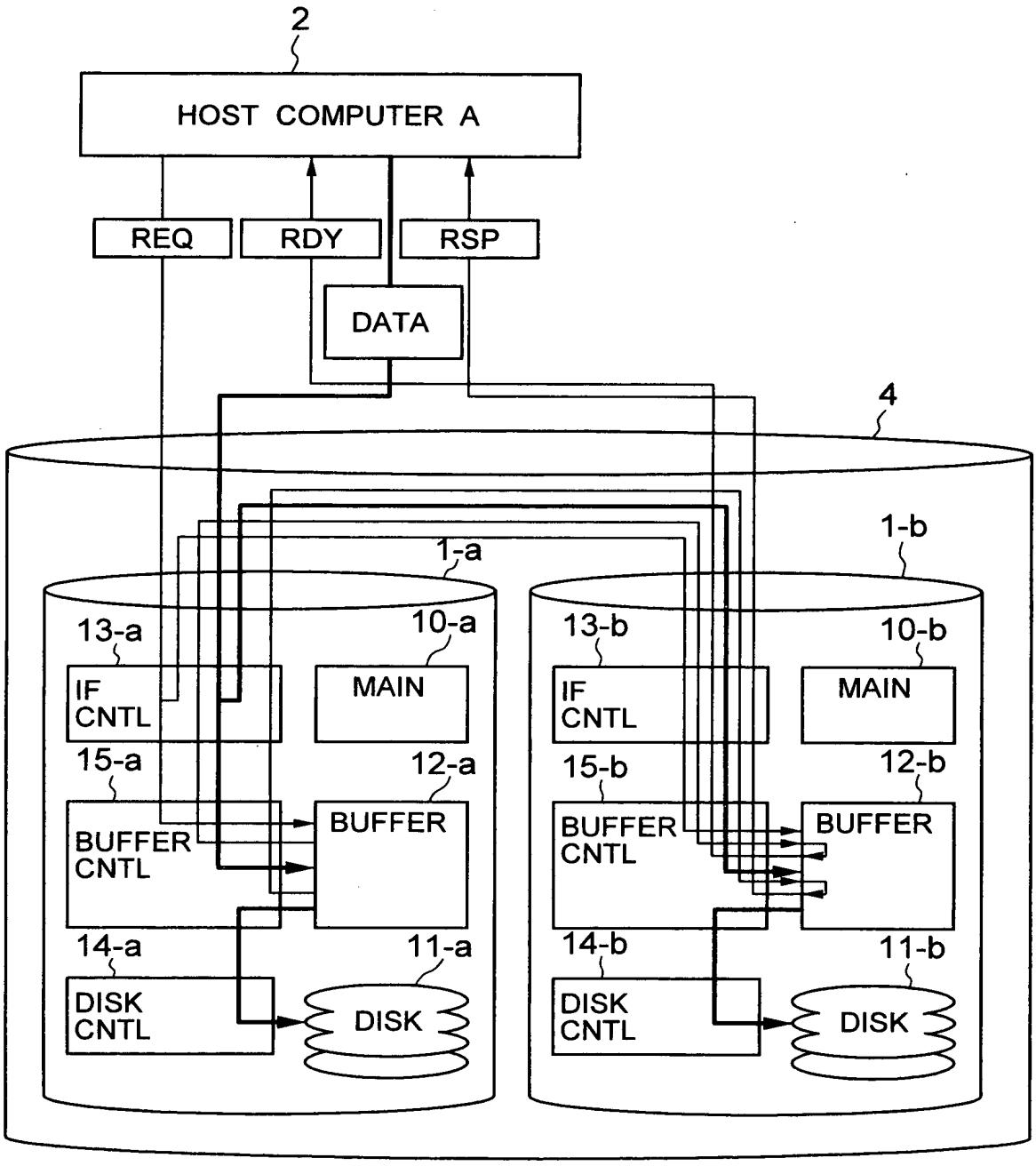
2
HOST COMPUTER A
REQ
RDY
RSP
DATA
4
1-a
1-b
13-a
10-a
IF CNTL
MAIN
15-a
12-a
BUFFER CNTL
BUFFER
14-a
11-a
DISK CNTL
DISK
13-b
10-b
IF CNTL
MAIN
15-b
12-b
BUFFER CNTL
BUFFER
14-b
11-b
DISK CNTL
DISK

FIG. 16

COOPERATION CONTROL INFORMATION ITEM		EXAMPLE OF SETTING FOR STORAGE DEVICE #1	EXAMPLE OF SETTING FOR STORAGE DEVICE #2
STORAGE SYSTEM ID (SHARED ID)		ID_0	ID_0
STORAGE DEVICE ID (UNIQUE ID)		ID_1	ID_2
COOPERATION STORAGE DEVICE ID (ID UNIQUE TO COOPERATION STORAGE DEVICE)		ID_2	ID_1
COOPERATION PROCESSING (COMMAND TRANSFER) MODE		COMMAND RETRANSMISSION	COMMAND RECEPTION
AREA MANAGEMENT INFORMATION	COOPERATION PROCESSING AREA	0- (N-1)	0- (N-1)
	ACTIVE AREA START ADDRESS	0	N / 2
	ACTIVE AREA SIZE	N / 2	N / 2

FIG. 17

BYTE \ BIT	7	6	5	4	3	2	1	0
0-7	FCP_LUN							
8	COMMAND REFERENCE NUMBER							
9	RESERVED					TASK ATTRIBUTE		
10	TASK MANAGEMENT FLAGS							
11	RESERVED					RD DATA	WR DATA	
12	OPERATION CODE							
13	LOGICAL UNIT NUMBER				FLAG			
14-17	LOGICAL BLOCK ADDRESS							
18	RESERVED							
19-20	TRANSFER LENGTH							
21	CONTROL							
22-27	RESERVED							
28-31	FCP_DL							

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FIG. 18

WORD \ BYTE	3	2	1	0
0	R_CTL	D_ID		
1	CS_CTL	S_ID		
2	TYPE	F_CTL		
3	SEQ_ID	SEQ_ID	SEQ_CNT	
4	OX_ID		RX_ID	
5	PARAMETER			

FIG. 19

#	HOST ID (S_ID)	OX_ID	RX_ID
0	ID_3	OX_00	RX_00
1	ID_3	OX_01	RX_02
2	ID_4	OX_01	RX_04
·	—	—	—
N	—	—	—

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FIG. 20

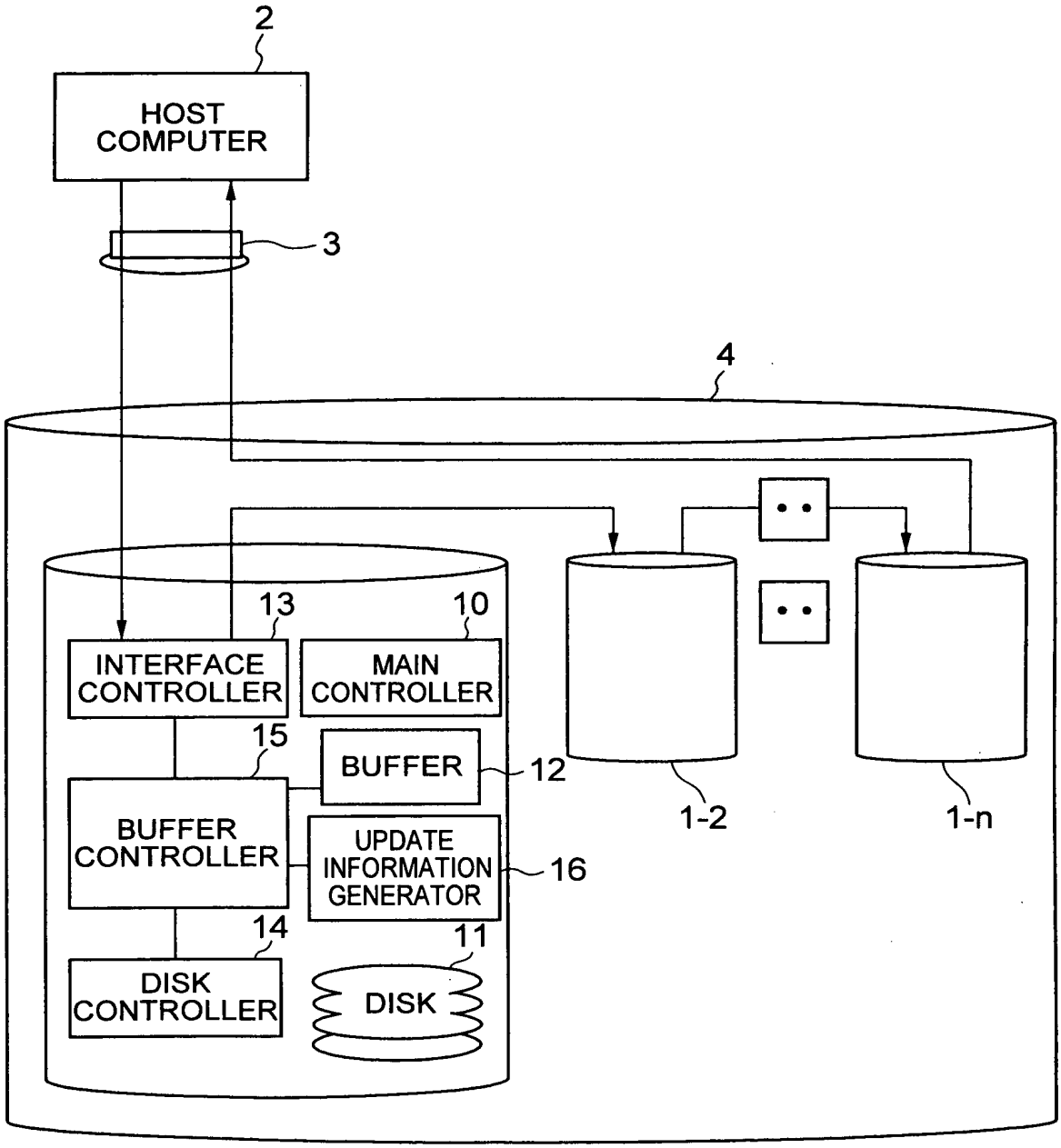
2
HOST COMPUTER
3
4
13
10
INTERFACE CONTROLLER
MAIN CONTROLLER
15
BUFFER
12
BUFFER CONTROLLER
UPDATE INFORMATION GENERATOR
16
14
11
DISK CONTROLLER
DISK
1-2
1-n

FIG. 21

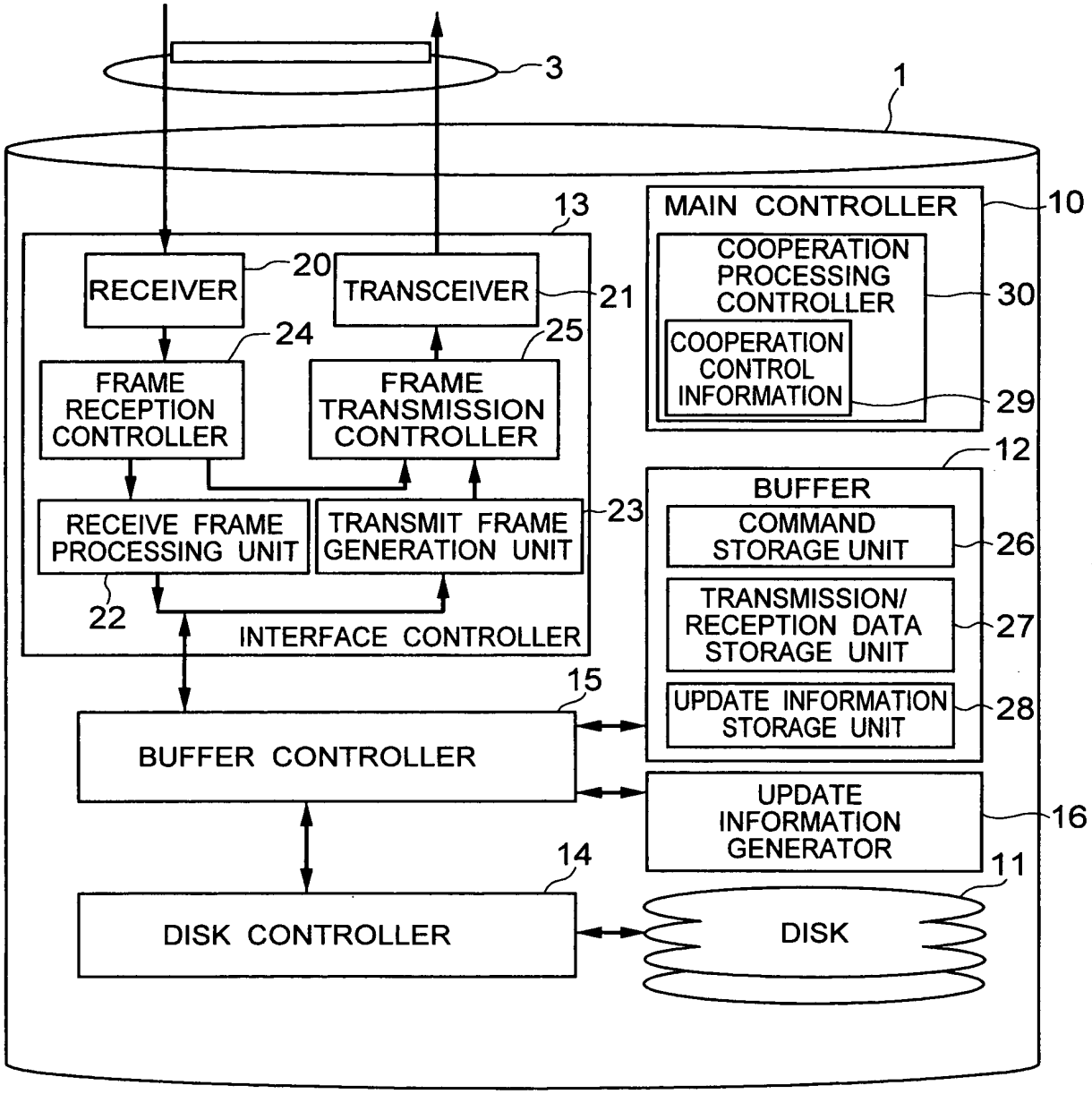
3
1
13
MAIN CONTROLLER
10
RECEIVER
20
TRANSCEIVER
21
COOPERATION PROCESSING CONTROLLER
30
24
25
FRAME RECEPTION CONTROLLER
FRAME TRANSMISSION CONTROLLER
COOPERATION CONTROL INFORMATION
29
12
BUFFER
RECEIVE FRAME PROCESSING UNIT
TRANSMIT FRAME GENERATION UNIT
23
COMMAND STORAGE UNIT
26
TRANSMISSION/ RECEPTION DATA STORAGE UNIT
27
22
INTERFACE CONTROLLER
15
UPDATE INFORMATION STORAGE UNIT
28
BUFFER CONTROLLER
UPDATE INFORMATION GENERATOR
16
14
11
DISK CONTROLLER
DISK

FIG. 22

COOPERATION CONTROL INFORMATION ITEM		STORAGE DEVICE #1	STORAGE DEVICE #2	STORAGE DEVICE #N
STORAGE SYSTEM ID (SHARED ID)		ID_0	←	←
STORAGE DEVICE ID (UNIQUE ID)		ID_1	ID_2	ID_N
POSITION MAP		1	2	N
COMMAND TRANSFER MODE		RECEPTION & RETRANSMISSION	RECEPTION & RETRANSMISSION	RECEPTION ONLY
REDUNDANT CONFIGURATION MANAGEMENT INFORMATION	RAID LEVEL	5	←	←
	NO. OF DATA DISKS	N-1	←	←
	NO. OF REDUNDANT DATA DISKS	1	←	←
	REDUNDANT DATA MANAGEMENT SIZE	64 (kB)	←	←

FIG. 23

SOF	HEADER	PAYLOAD	CRC	EOF

FIG. 24

WORD \ BYTE	3	2	1	0
0	R_CTL	D_ID		
1	CS_CTL	S_ID		
2	TYPE	F_CTL		
3	SEQ_ID	SEQ_ID	SEQ_CNT	
4	OX_ID		RX_ID	
5	PARAMETER			

FIG. 25

BYTE \ BIT	7	6	5	4	3	2	1	0
0-7	FCP__LUN							
8	COMMAND REFERENCE NUMBER							
9	RESERVED					TASK ATTRIBUTE		
10	TASK MANAGEMENT FLAGS							
11	RESERVED					RD DATA	WR DATA	
12	OPERATION CODE							
13	LOGICAL UNIT NUMBER				FLAG			
14-17	LOGICAL BLOCK ADDRESS							
18	RESERVED							
19-20	TRANSFER LENGTH							
21	CONTROL							
22-27	RESERVED							
28-31	FCP__DL							

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FIG. 26

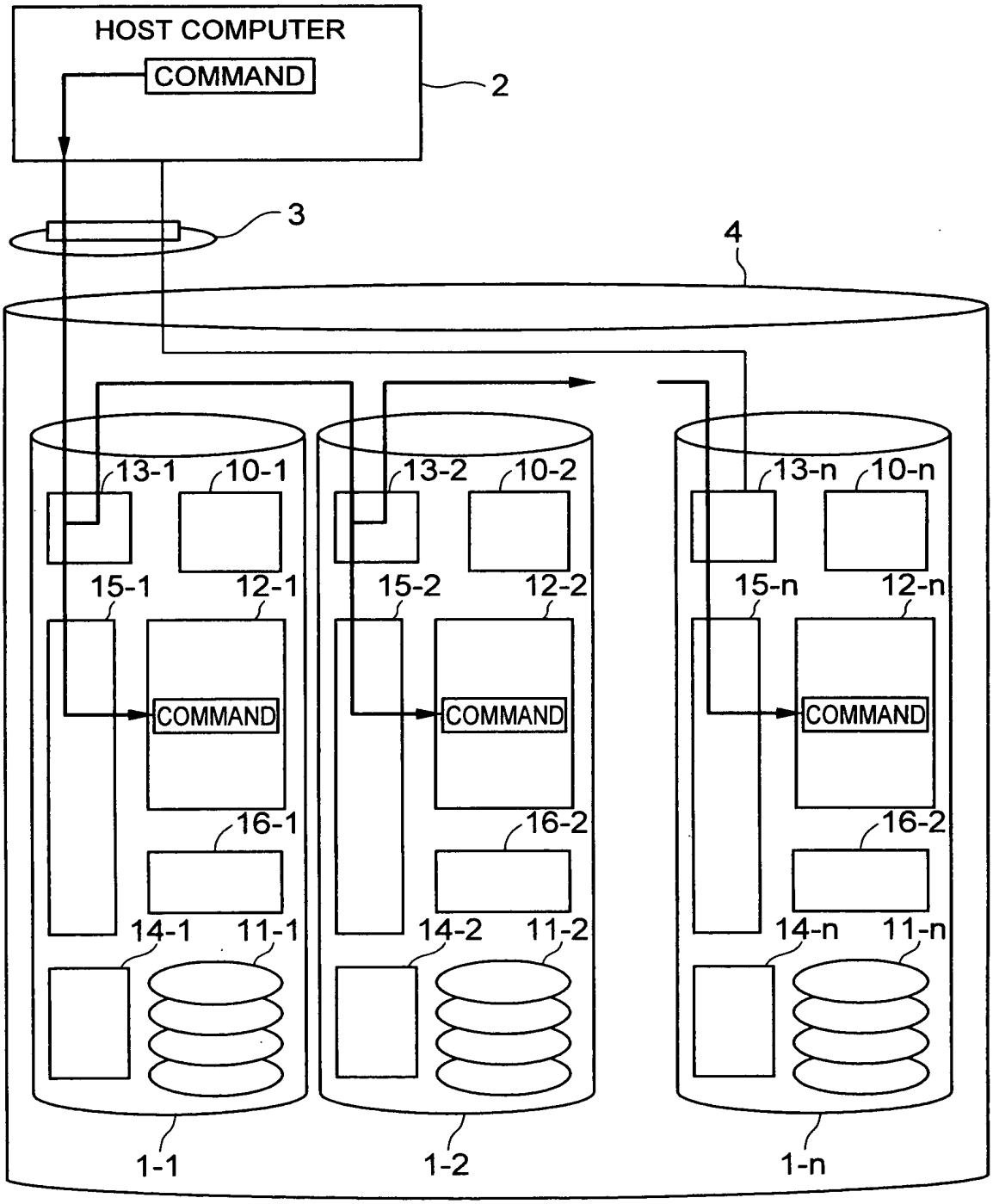
HOST COMPUTER
COMMAND
2
3
4
13-1
10-1
13-2
10-2
13-n
10-n
15-1
12-1
15-2
12-2
15-n
12-n
COMMAND
COMMAND
COMMAND
16-1
16-2
16-2
14-1
11-1
14-2
11-2
14-n
11-n
1-1
1-2
1-n

FIG. 27

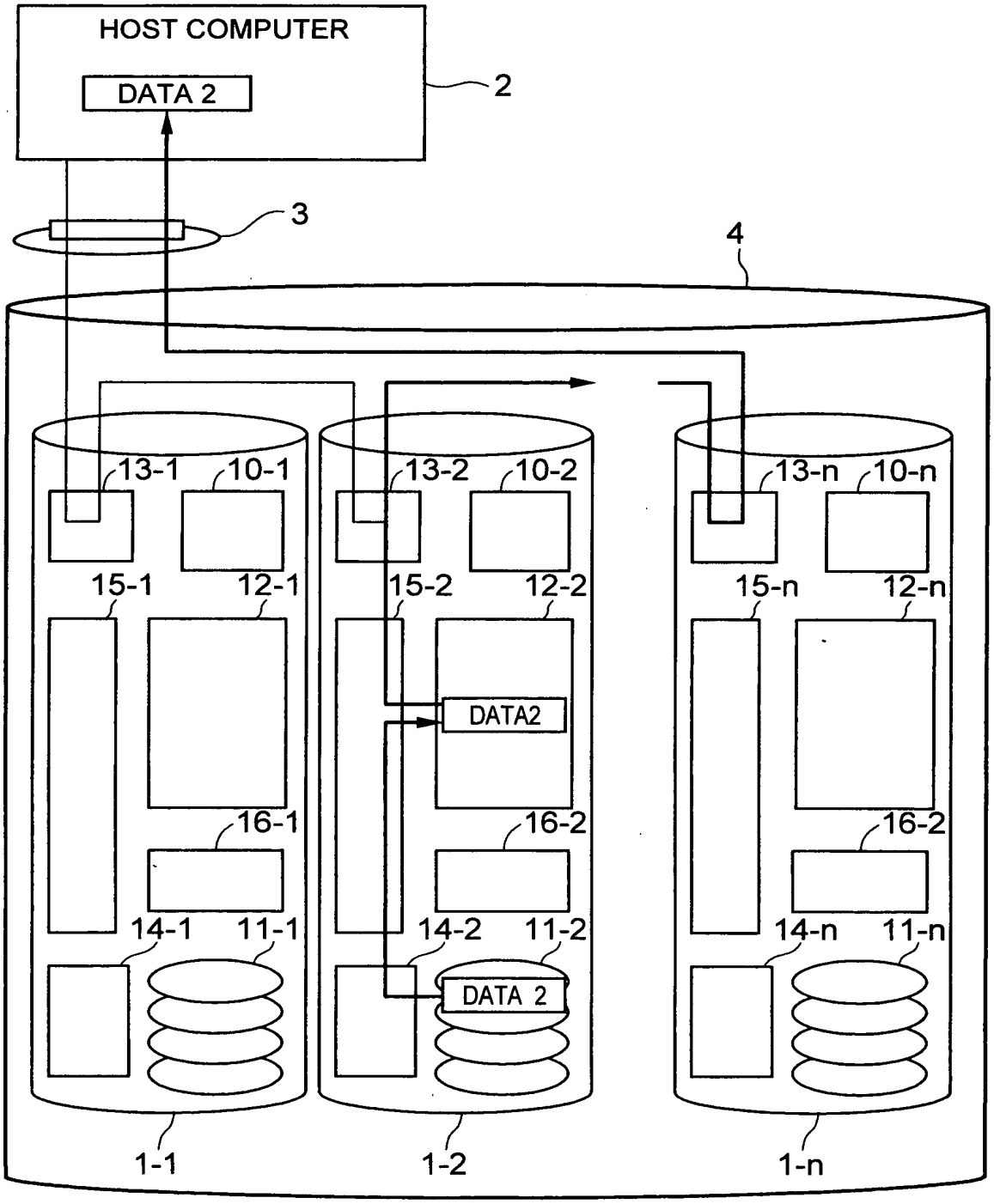
HOST COMPUTER
DATA 2
2
3
4
13-1
10-1
13-2
10-2
13-n
10-n
15-1
12-1
15-2
12-2
15-n
12-n
DATA2
16-1
16-2
16-2
14-1
11-1
14-2
11-2
14-n
11-n
DATA 2
1-1
1-2
1-n

FIG. 28

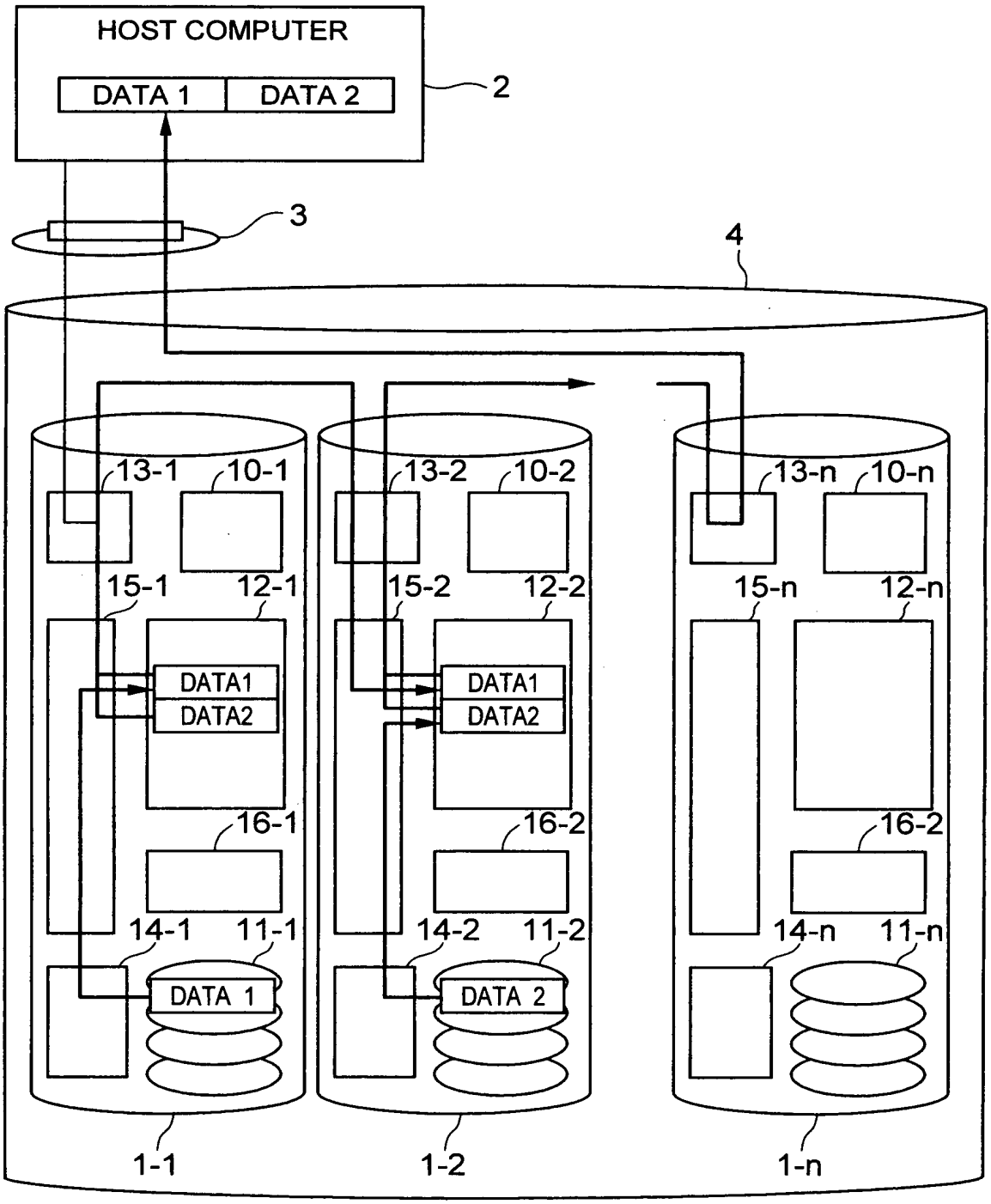
HOST COMPUTER
DATA 1
DATA 2
2
3
4
13-1
10-1
13-2
10-2
13-n
10-n
15-1
12-1
15-2
12-2
15-n
12-n
DATA1
DATA2
DATA1
DATA2
16-1
16-2
16-2
14-1
11-1
14-2
11-2
14-n
11-n
DATA 1
DATA 2
1-1
1-2
1-n

FIG. 29

BYTE \ BIT	7	6	5	4	3	2	1	0
0-X	DATA_VALID BIT							
-	USER (READ/WRITE) DATA SEGMENT 0							
-	:							
-	USER (READ/WRITE) DATA SEGMENT n							

2002-0230-US-PCT

FIG. 30

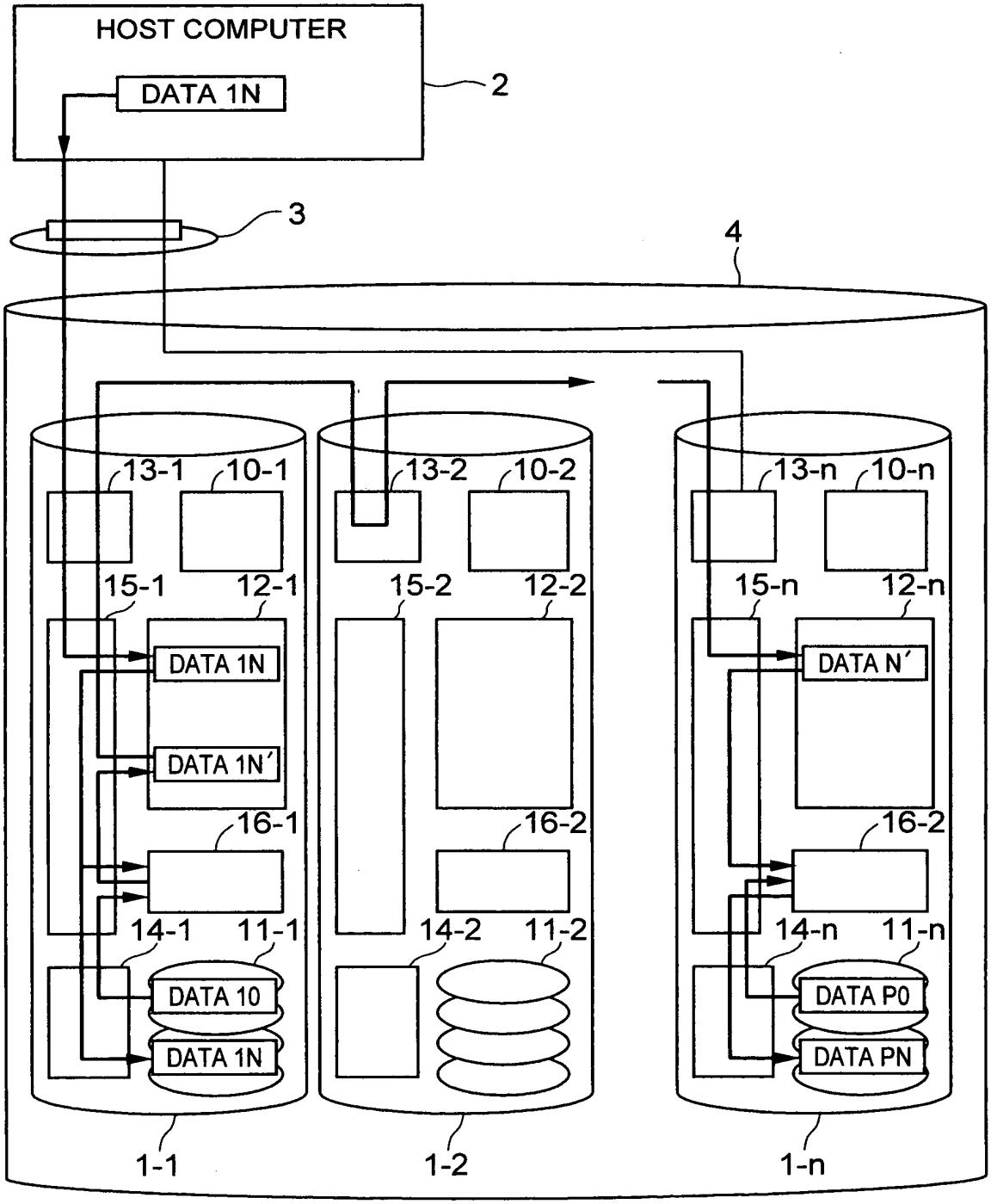
HOST COMPUTER
DATA 1N
2
3
4
13-1
10-1
13-2
10-2
13-n
10-n
15-1
12-1
15-2
12-2
15-n
12-n
DATA 1N
DATA 1N'
DATA N'
16-1
16-2
16-2
14-1
11-1
14-2
11-2
14-n
11-n
DATA 10
DATA 1N
DATA P0
DATA PN
1-1
1-2
1-n

FIG. 31

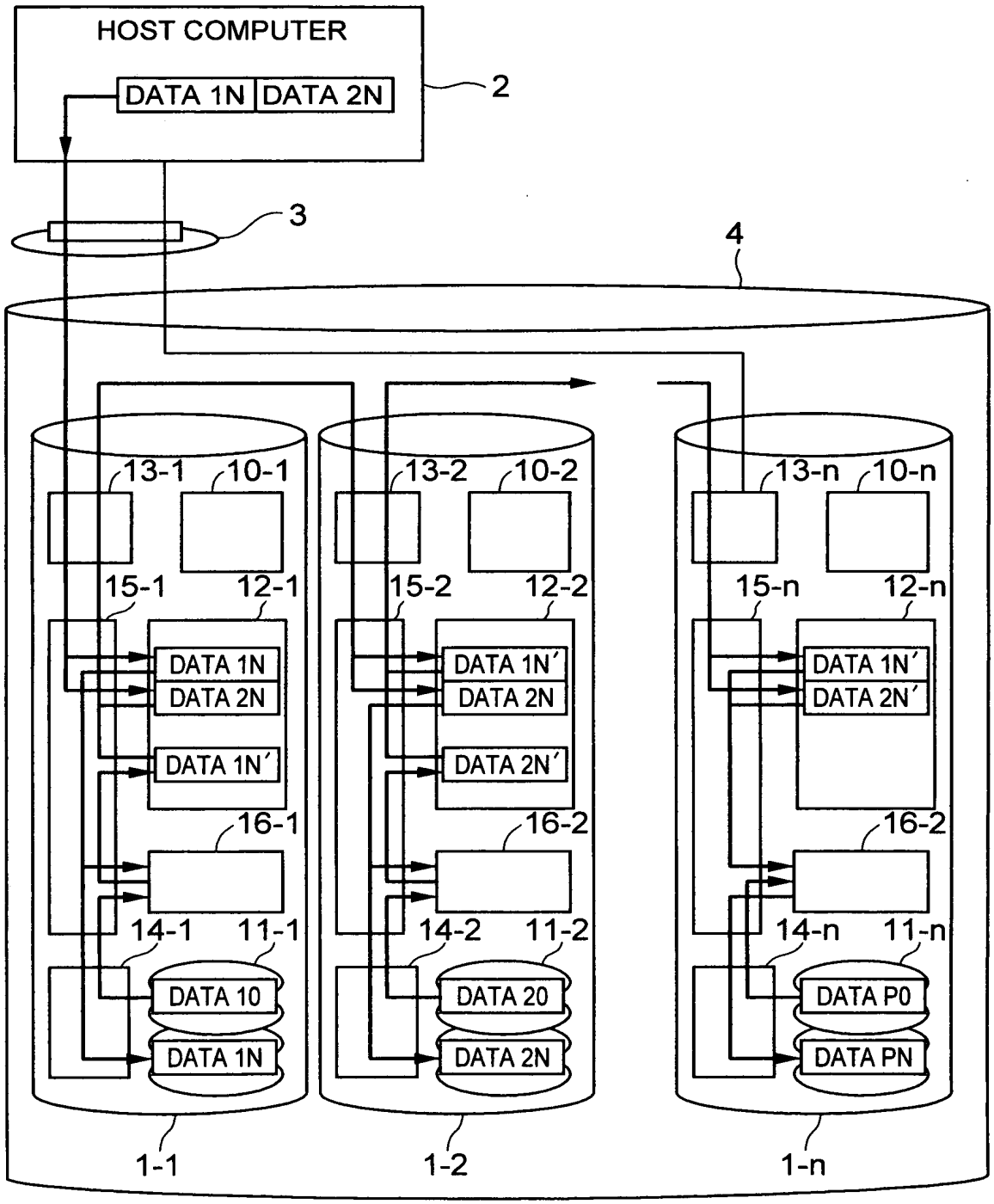
HOST COMPUTER
DATA 1N
DATA 2N
2
3
4
13-1
10-1
13-2
10-2
13-n
10-n
15-1
12-1
15-2
12-2
15-n
12-n
DATA 1N
DATA 2N
DATA 1N'
DATA 1N'
DATA 2N
DATA 2N'
DATA 2N'
DATA 1N'
DATA 2N'
16-1
16-2
16-2
14-1
11-1
14-2
11-2
14-n
11-n
DATA 10
DATA 1N
DATA 20
DATA 2N
DATA P0
DATA PN
1-1
1-2
1-n

FIG. 32

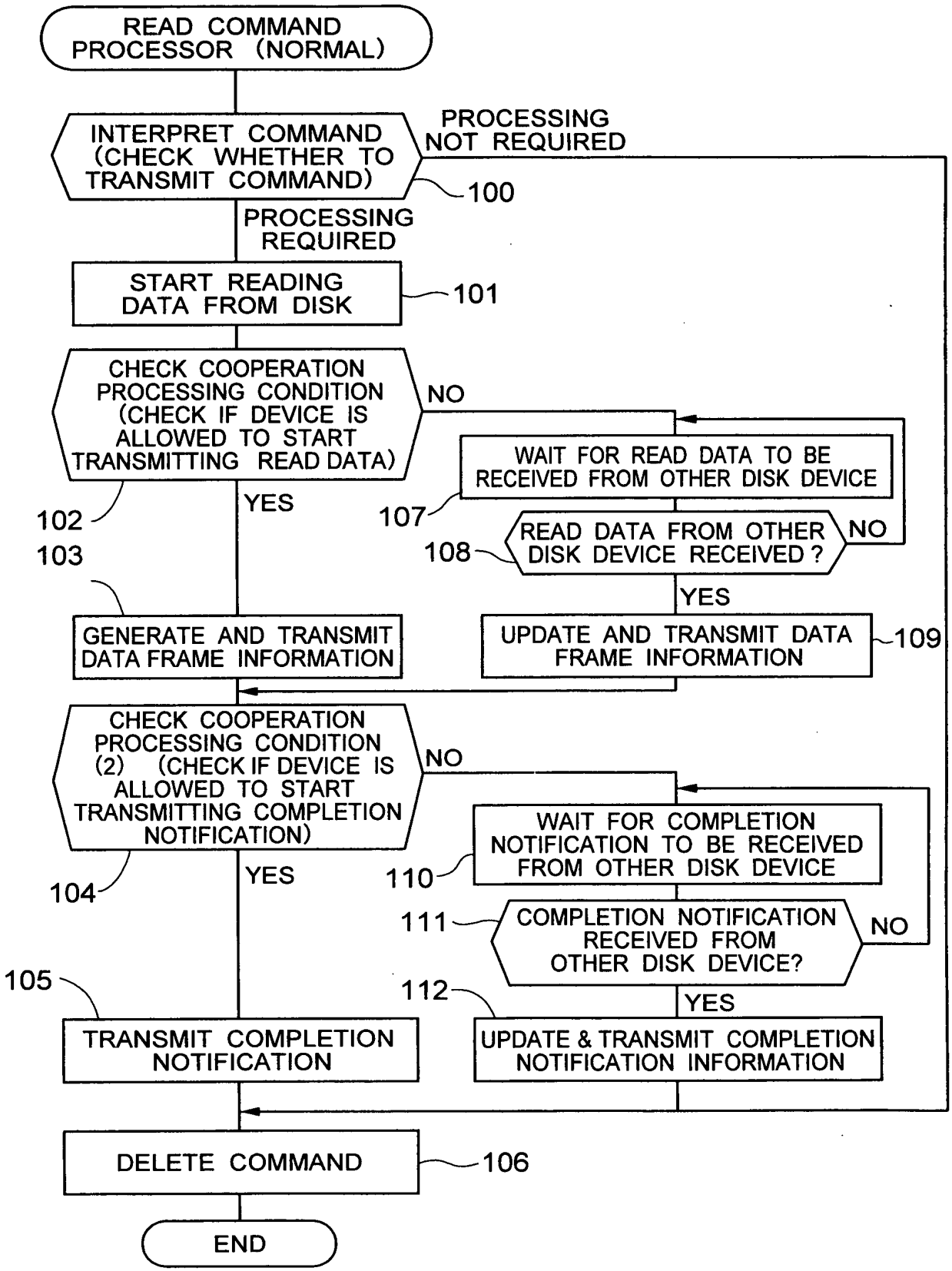

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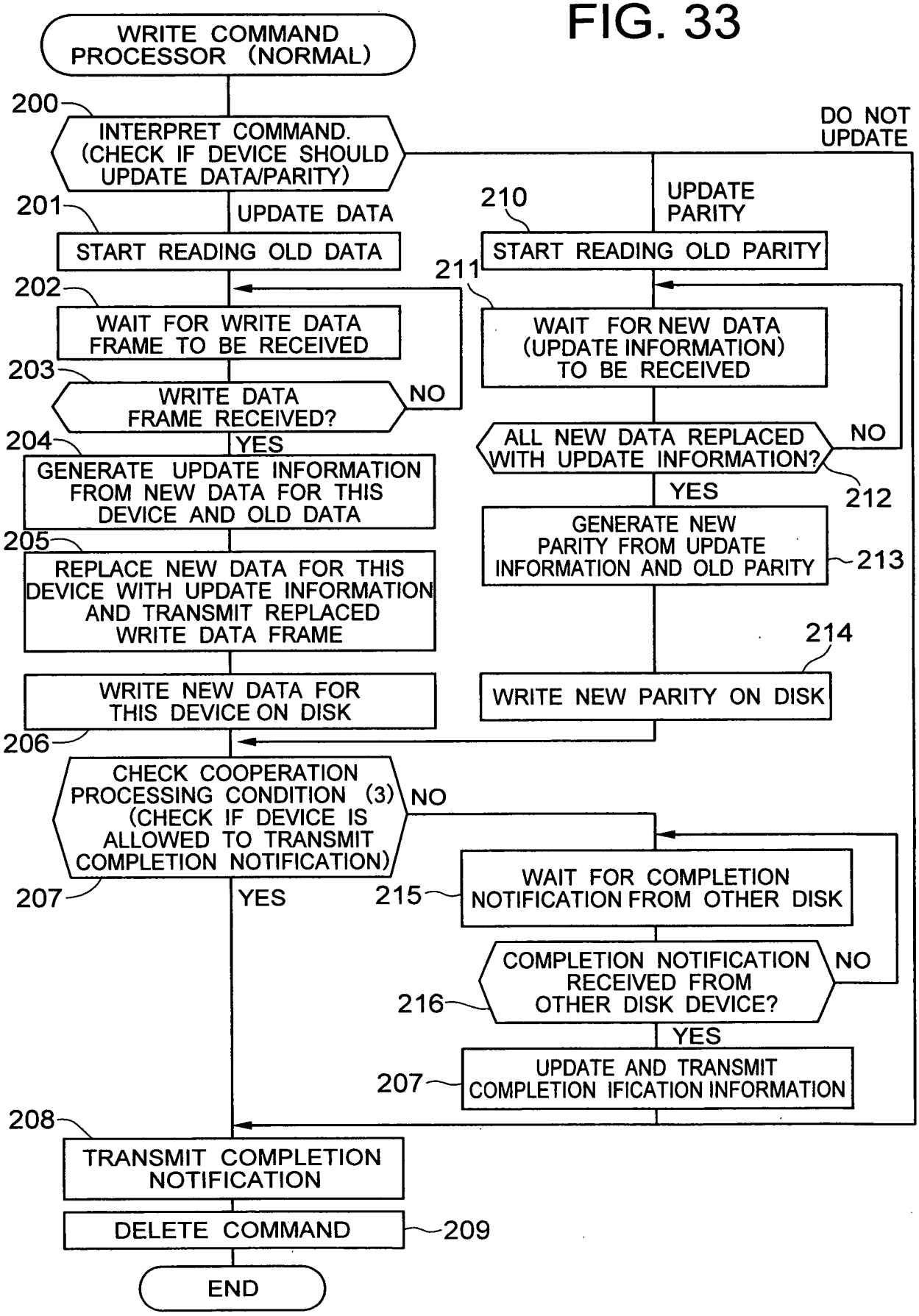
FIG. 33



2005-0232808

FIG. 34

COOPERATION CONTROL INFORMATION ITEM		STORAGE DEVICE #1	STORAGE DEVICE #2	STORAGE DEVICE #N
STORAGE SYSTEM ID (SHARED ID)		ID_0	←	←
STORAGE DEVICE ID (UNIQUE ID)		ID_1	ID_2	ID_N
POSITION MAP		1	2	N
COMMAND TRANSFER MODE		RECEPTION & RETRANSMISSION	RECEPTION & RETRANSMISSION	RECEPTION ONLY
REDUNDANT CONFIGURATION MANAGEMENT INFORMATION	RAID LEVEL	5	←	←
	NO. OF DATA DISKS	3	←	←
	NO. OF REDUNDANT DATA DISKS	1	←	←
	REDUNDANT DATA MANAGEMENT SIZE	64 (kB)	←	←
	OPERATION MODE (NORMAL/FALLBACK)	FALLBACK	←	←
	FAILING STORAGE DEVICE ID	ID_2	←	←

2005-0202804

FIG. 35

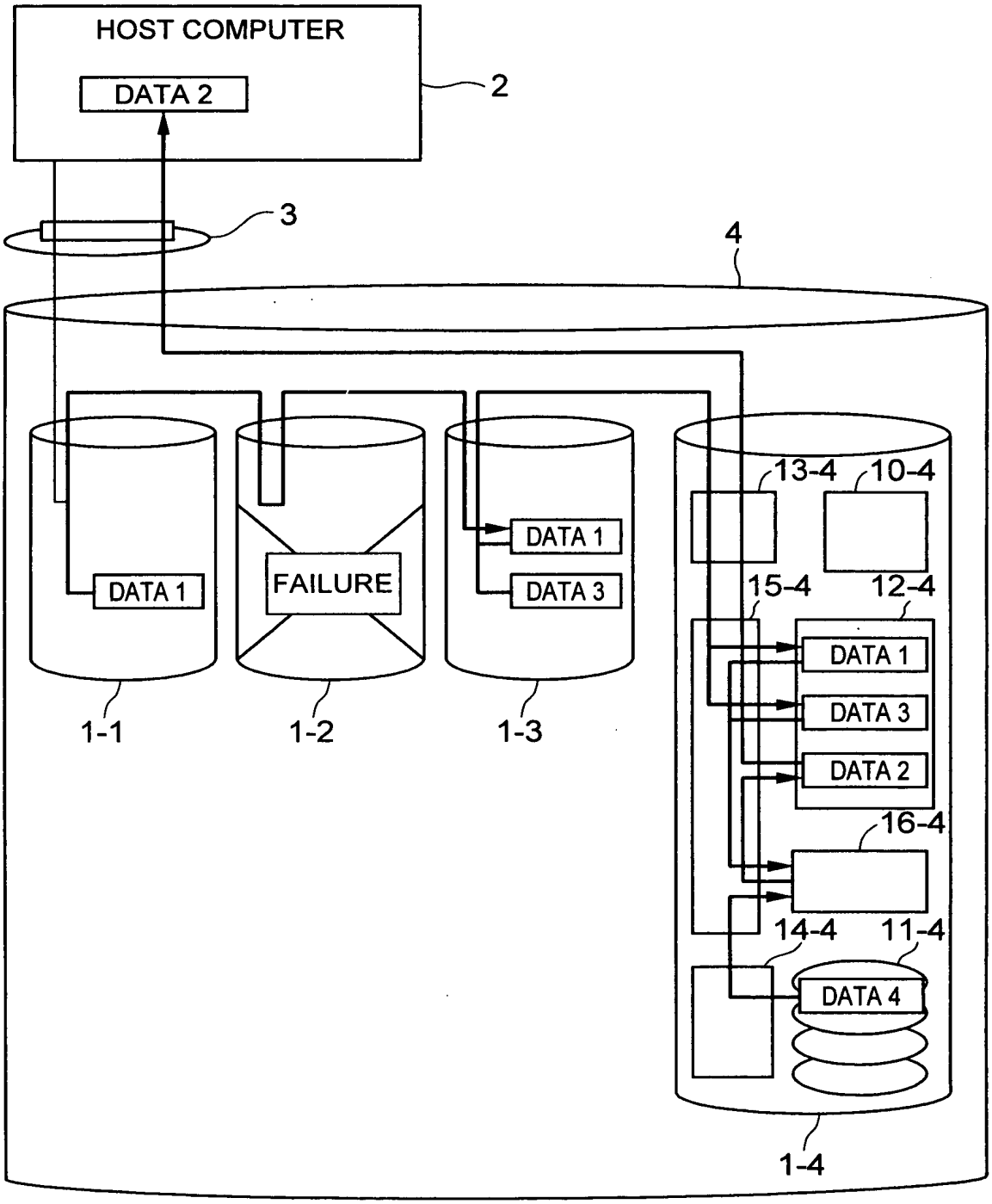

HOST COMPUTER
DATA 2
2
3
4
DATA 1
FAILURE
DATA 1
DATA 3
1-1
1-2
1-3
13-4
10-4
15-4
12-4
DATA 1
DATA 3
DATA 2
16-4
14-4
11-4
DATA 4
1-4

FIG. 36

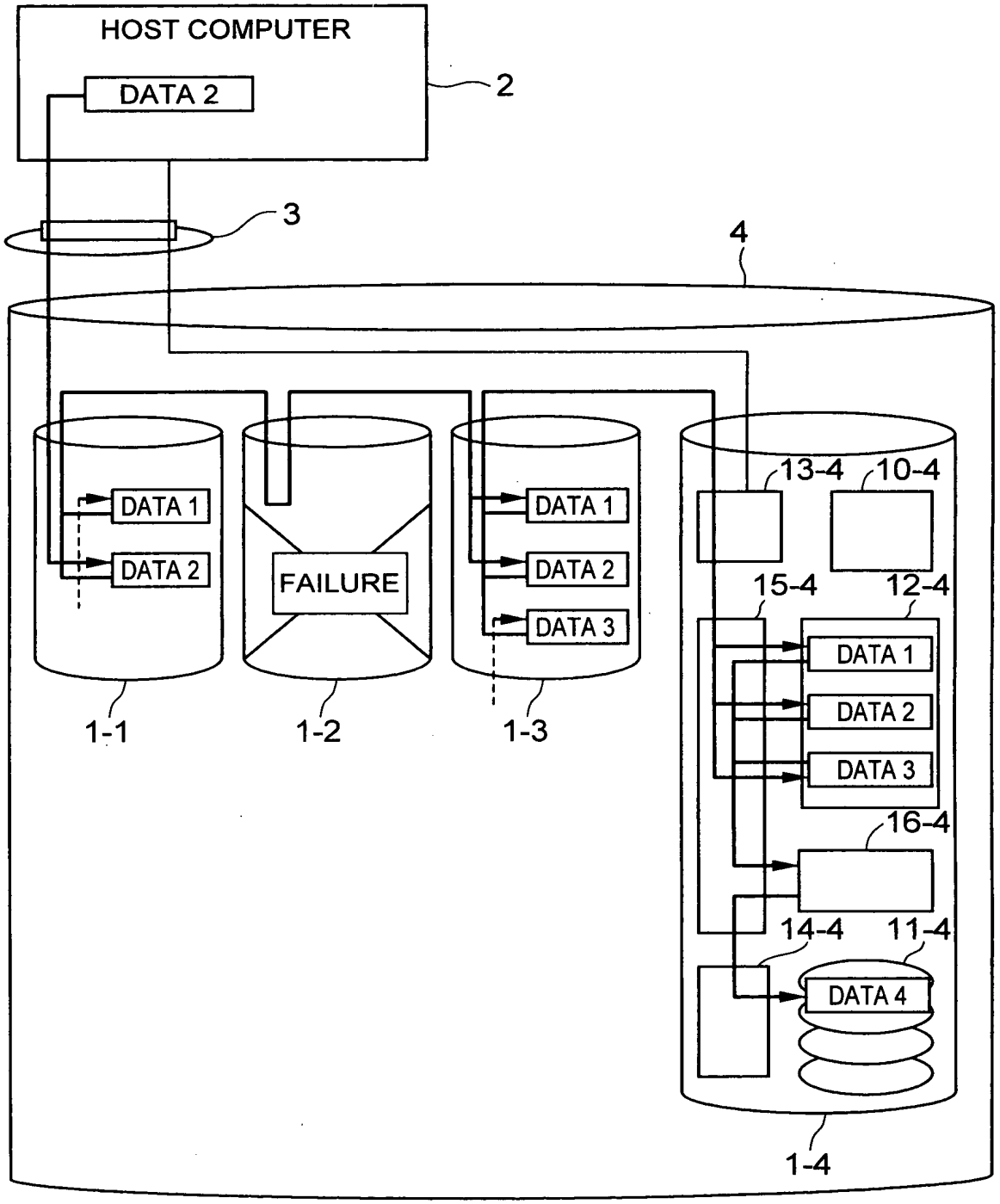

HOST COMPUTER
DATA 2
2
3
4
DATA 1
DATA 2
FAILURE
DATA 1
DATA 2
DATA 3
13-4
10-4
15-4
12-4
DATA 1
DATA 2
DATA 3
16-4
14-4
11-4
DATA 4
1-1
1-2
1-3
1-4

FIG. 37

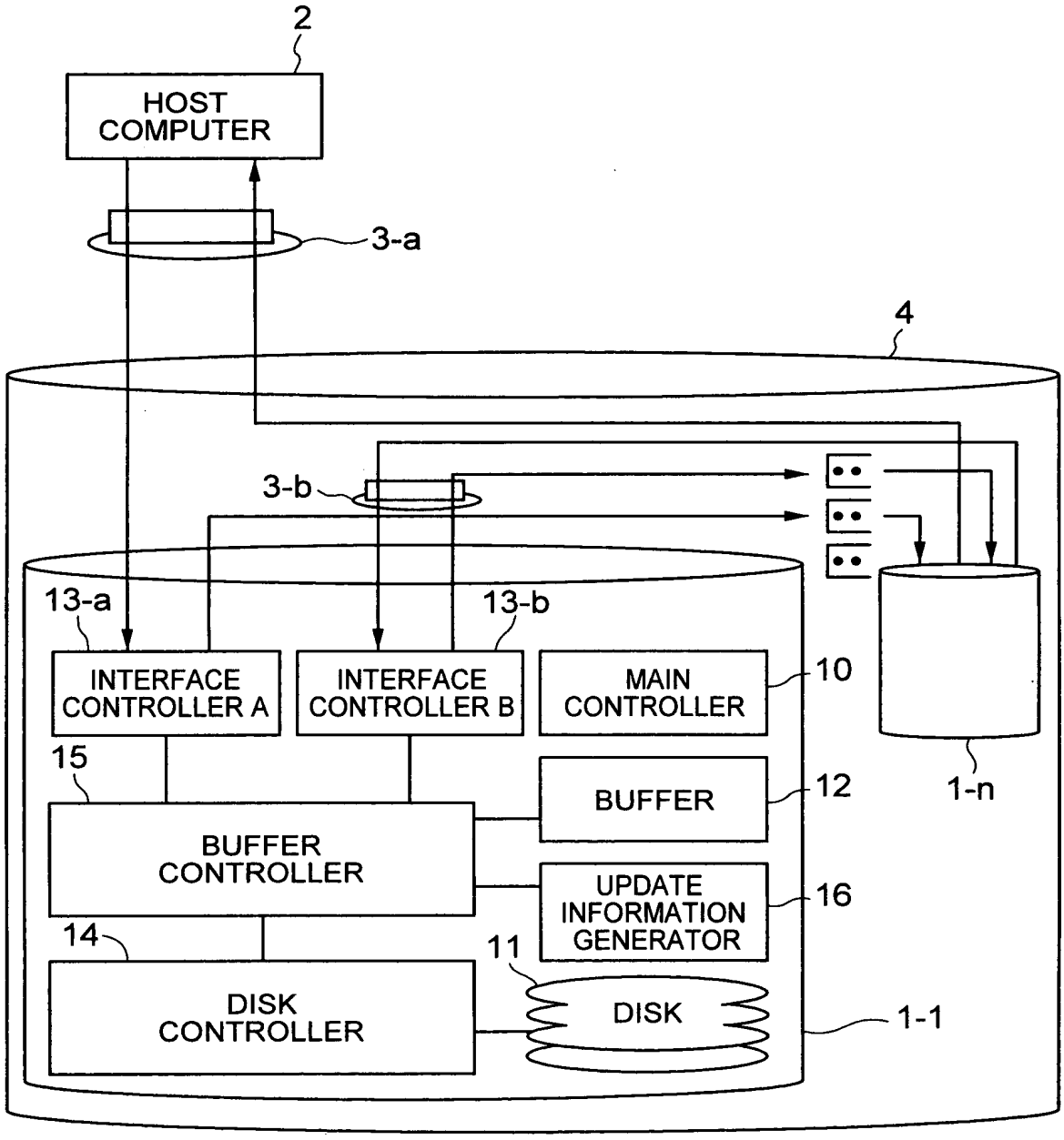
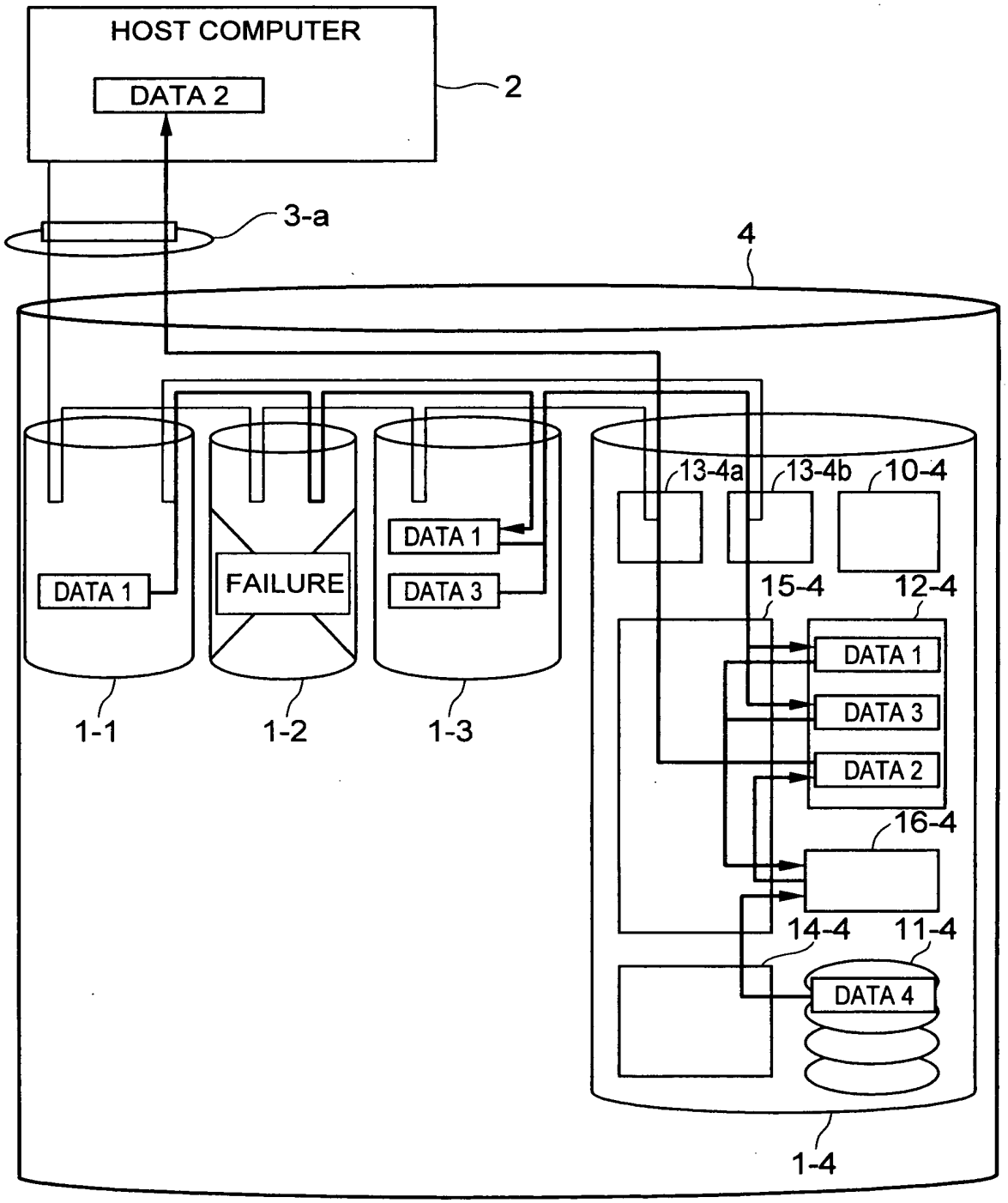

2
HOST COMPUTER
3-a
4
3-b
13-a
13-b
INTERFACE CONTROLLER A
INTERFACE CONTROLLER B
MAIN CONTROLLER
10
15
BUFFER
12
1-n
BUFFER CONTROLLER
UPDATE INFORMATION GENERATOR
16
14
11
DISK CONTROLLER
DISK
1-1

FIG. 38


HOST COMPUTER
DATA 2
2
3-a
4
DATA 1
FAILURE
DATA 1
DATA 3
13-4a
13-4b
10-4
15-4
12-4
DATA 1
DATA 3
DATA 2
16-4
14-4
11-4
DATA 4
1-1
1-2
1-3
1-4